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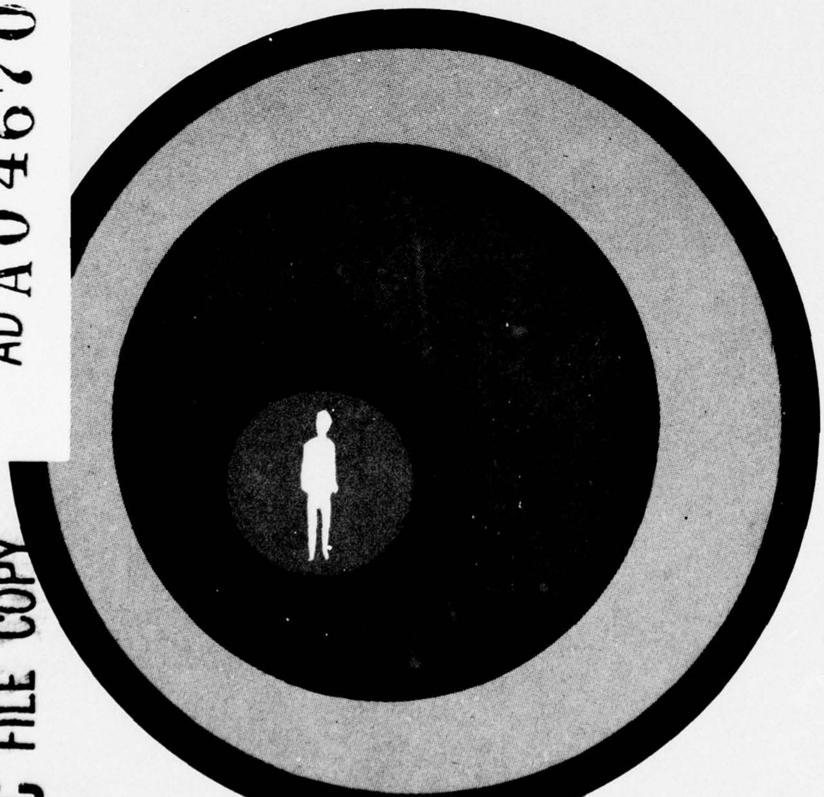
TAEG REPORT
NO. 37

DESIGN OF TRAINING SYSTEMS
PHASE IV REPORT



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OCTOBER 1976

TRAINING ANALYSIS AND EVALUATION GROUP
ORLANDO, FLORIDA 32813

TAEG REPORT NO. 37

DESIGN OF TRAINING SYSTEMS

PHASE IV REPORT

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This Study Was Performed By

International Business Machines Corporation

for the

Training Analysis and Evaluation Group

October 1976

Alfred F. Smode

ALFRED F. SMODE, Ph.D., Director
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This final report summarizes the functional analysis, design, and development activities associated with the Training Requirements Analysis Model (TRAM). It also includes final study data on the DOTS Utility Assessment conducted at TRAPAC, San Diego, CA. The major utility assessment information is included in TAEG Report 29, Program Maintenance Manual; TAEG Report 30, User's Guide; and TAEG Report 33, DOTS Utility Assessment. Phase IV is a part of a Design of Training Systems contractual effort, Contract No.

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Phases I, II and III were accomplished by the IBM Federal Systems Division with the Training Analysis and Evaluation Group, Orlando, Florida, providing technical guidance and support. The overall DOTS' objective is to provide Naval Education and Training Command (NAVEDTRACOM) management with additional tools in the form of computerized mathematical models to assist in predicting the quantitative impact of training resource decisions. The planning process will be enhanced by providing decision makers with the capability to economically and rapidly consider a wider range of alternatives.

Phase I was a study and definition effort resulting in a complete functional description of the NAVEDTRACOM; a strategic definition of the social, political, economic and technological environments pertinent to the naval education and training system in the 1980's; a list of existing and potential models amenable to computerization and to improving the decision-making process. Phase II was devoted to the selection and development of three mathematical models from the Phase I list of candidates. The three were the System Capabilities/Requirements and Resources (SCRR), the Educational Technology Evaluation (ETE), and the Training Process Flow (TPF) models.

Phase III centered on evaluating the selected models at the Fleet Training Center, Norfolk, VA. An important recommendation from the Test and Evaluation conducted during Phase III was that DOTS should investigate model applications at higher command levels. TRAM responds to this recommendation.

The Phase IV TRAM development began with a functional analysis performed in the latter months of 1975. Functional descriptions were developed and reviewed with personnel at CNTECHTRA, Memphis, Tennessee. Model design and development proceeded from these preliminary specifications. A field test at CNTECHTRA was scheduled in October 1976, with this Phase IV Final Report containing the results.

The Phase IV DOTS Utility Assessment at TRAPAC yielded significant cost and resource data which will be useful in planning follow-on application and model development efforts. These results are also incorporated into this report.

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FOREWORD

The Design of Training Systems (DOTS) project objectives are in consonance with the requirements of Advanced Development Objective ZPN07 (formerly ADO 4303X), Education and Training Development. ZPN07 includes a number of projects concerned with demonstrating and evaluating the technical, operational and financial feasibility of applying advanced technological applications to improving the training process.

The Bureau of Naval Personnel initiated the original ADO in 1966 to make naval training more responsive to the changing times. As one project under this effort, DOTS was designed to improve the process of managing training resources through application of the techniques of system analysis and system simulation as accomplished through mathematical modeling. The end objective is a family of computerized mathematical models enabling training management to more rapidly predict the impact of changes in training resource availability or requirements.

The majority of education and training was reorganized in 1971 under one command, Chief of Naval Education and Training (CNET). Because of this change, DOTS responsibility was transferred to CNET in March of 1972; more specifically, to the Training Analysis and Evaluation Group (TAEG), Orlando, Florida. The new CNET organization greatly increased the potential benefits to be gained from the increased application of new management techniques and, therefore, from the DOTS' R&D effort. DOTS began in February of 1973, with the majority of tasking being contracted to the International Business Machines Corporation, Federal Systems Division, Cape Kennedy Facility, located at Cape Canaveral, Florida.

Chief of Naval Technical Training (CNTECHTRA) personnel providing substantial input to TRAM design were: CDR Ian Watson, CDR Jack Davis, Mrs. Jerry Trobaugh, and Messrs. John Andrews, Bill Cox, Jerry Glad, Moreland Ray, Mel Robey, Dave Thomas, Wilson Thomas and Richard Trannis. Their participation in this effort is greatly appreciated.

Mr. Ray Bryant and LCDR Tom Ferrier contributed significantly to the finalization of DOTS model enhancements and to the installation of the major data base maintenance system at COMTRAPAC. John Finnegan at TRAPAC provided exceptional cooperation to both of the above tasks.

The Training Analysis and Evaluation Group, Dr. A. F. Smode, Director; project team members Messrs. M. Middleton and W. Lindahl, complemented the contracted effort by providing direction and guidance, establishing organizational interfaces, and assisting in the performance of the utility assessment.

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SECTION I

INTRODUCTION

BACKGROUND

The Training Requirements Analysis Model (TRAM), developed in Phase IV, is the result of recommendations from the Phase III Test and Evaluation (T&E) of the training center models.[1] These earlier developed models were employed in a rather well-defined sector of the training system. Their application within the training system was analyzed in a prior report.[2] The final study results of those models are described in Section V of this report.

The analysis and design of the training center level models established a knowledge and technology base, part of which was incorporated into TRAM. This transfer of an application and technology framework assisted the integration of TRAM objectives with the overall project goal, namely to provide training management with the visibility and control necessary for the effective planning of resources required to meet a wide range of training demands. It was, however, recognized that this goal could be met best with models targeted at the Functional Command and Chief of Naval Education and Training (CNET) level.

The TRAM functional analysis proceeded from the in-depth review of the prior models to a more specific information-gathering task at these higher command levels. Several meetings were held between the project analysts and key training officials responsible for program and resource planning at CNET, Chief of Naval Technical Training (CNTECHTRA), Commander Training Command, U.S. Atlantic Fleet (COMTRALANT), and Commander Training Command, U.S. Pacific Fleet (COMTRAPAC). The meetings, part of the early Phase IV effort, identified the requirements of the Functional Commands so that the TRAM specification effectively melded the prior modeling technology base with the stated needs of the training managers.

TRAM OBJECTIVES

The objectives of the TRAM portion of Phase IV of the DOTS project were as follows:

1. To merge the technologies developed for the Training Process Flow (TPF) model and the System Capabilities/Requirements and Resources (SCRR) model into a new model for student and resource planning and management. This new model should test the feasibility of meeting planned training loads with available

[1] DiGialleonardo, Frank, 1976. Design of Training Systems (DOTS) Project: Test and Evaluation of Phase II Models. Special Report 76-10, Navy Personnel Research and Development Center, San Diego, CA.

[2] Duffy, Larry R., 1976. DOTS Utility Assessment: The Training Process Flow and System Capabilities/Requirements and Resources Models Operating in the TRAPAC Environment. TAEG Report No. 33, Training Analysis and Evaluation Group, Orlando, FL.

resources, calculate resources required to meet new requirements, and indicate resource surpluses on a training center (UIC) basis.

2. To identify data required and to establish and validate a baseline data base for use in model testing and validation.

3. To study the entire Program Budget Decision (PBD) process at the CNET and Functional Command level, including CNET's role in the overall Planning, Programming and Budgeting System to assure the TRAM model fills a useful role in providing managerial support.

The resultant of this phase of the project is to be a computer-based model/ data base system usable at the CNET/Functional Command level which will augment the existing decision process relative to increments, decrements, feasibility studies, Program Budget Decision, etc.

TRAM DEVELOPMENT TASKS

The TRAM portion of Phase IV was broken into two major tasks.

TASK 1 - DEFINE TRAM FUNCTIONAL SPECIFICATION. The design of a new model such as TRAM must start with the formulation of functional specifications, i.e., analysis of the purpose of the model and determination of the model application, data sources, and outputs. This task was divided into two parts. The initial part consisted of interviewing key personnel at CNET, CNTECHTRA, COMTRALANT, and COMTRAPAC. This was done concurrently with the analysis of documentation on existing Navy systems, such as Resource Management System (RMS), Navy Integrated Training Administration System (NITRAS), Recruit Allocation Control System (RACS), etc., and an analysis of all available literature concerning the entire Planning, Programming and Budgeting System as it relates to CNET.

The final step was to correlate the DOTS capabilities with the identified CNET/Functional Command requirements. The resultant of this task was the TRAM Functional Specification delivered in December 1975, and superseded by the TRAM Functional Description published in April 1976.

TASK 2 - DEVELOP TRAM. The second major task during the TRAM portion of Phase IV was the development of the TRAM model. The Functional Specification developed in TASK 1 was used as the basis for design. The model was constructed using a building-block technique, using the results of parametric studies and other analyses of the bulk data. This development is covered in Section III of this document. The final part of TASK 2 was a user evaluation or field test, conducted at CNTECHTRA. The results of this field test are contained in Section IV of this report.

SCRR AND TPF UTILITY ASSESSMENT AT TRAPAC TASKS

The SCRR and TPF Utility Assessment portion of Phase IV was divided into four major tasks.

TASK 1 - TRAPAC FIELD TEST. This task consisted of the installation of SCRR and TPF software at the Training Command Pacific (TRAPAC), identification of model/data base applications, utilization of the models to solve identified problems, definition of enhancements, and an evaluation by a Navy review team of the field test results. These results were documented in the DOTS UTILITY ASSESSMENT, TAEG Report No. 33.

TASK 2 - MODIFY SOFTWARE TO INCORPORATE ENHANCEMENTS. Three major enhancements identified during the TASK 1 field test were incorporated into the DOTS models/data base software. These included an instructor billet computation program, several data base format changes, and a new data base maintenance system. The major changes from this task were documented in the DOTS TRAPAC USER'S MANUAL, TAEG Report No. 36.

TASK 3 - TRAIN TRAPAC PERSONNEL, INSTALL SYSTEM. TRAPAC personnel were trained in the operation of the DOTS models/data base over a five-week period. During that same period, the new software was installed and personnel were trained in the use of the data base maintenance system. Maintenance and operational costs were recorded and have been incorporated into Section V of this report.

TASK 4 - SYSTEM DOCUMENTATION. The system documentation consisted of a combined user's guide and programmer's manual for the DOTS data base, SCRR, and TPF models (TAEG Report No. 36).

The primary focus of this report is to present the analysis, design, development, and test results that relate to TRAM. Sections II, III and IV of this report address these topics.

SECTION II

TRAM FUNCTIONAL ANALYSIS

TECHNICAL APPROACH

No analysis of a complex organization can be made without thoroughly understanding the business of that organization and how information systems support it. CNET, with the consolidation of all training under a single command, has a function larger and more complex than ever before. The command must cope with the large and varying numbers of trainees, controlling a far-flung organization, and adjusting with the technical advances that alter the training requirements as well as introducing challenges in the form of new training methods. The overriding goal of CNET can be stated quite simply: "To provide the fleet with a proficient occupant for every billet by means of the most efficient utilization of available resources."[3] In other words, the training command must make available to the fleet qualified individuals in the right place at the right time and in the right numbers.

Numerous analytic methods could have been applied to the study of the CNET organization. For this task, the job was broken into three steps. First, it was necessary to identify the preliminary activities required for a detailed study of CNET and the functional commands. Second, the activities necessary to understand the business of CNET, including how current information systems support it and what situations might be amenable to solution using mathematical models, were outlined. Third, the scope of the TRAM development effort had to be assessed in light of the identified requirements, considering existing resource capabilities and the extent to which prior modeling technology could be applied. These three steps led to the TRAM functional specification. Figure II-1 outlines this tasking structure in summary form.

DISCUSSION OF INDIVIDUAL TASKS

The identification step included the preparatory activities necessary to insure continuity and success in the accomplishment of the project objectives within a reasonable time period. By going through an identification step valuable time was saved by team members and travel was held to a minimum.

An initial activity was to develop a study action plan - that is, who would be responsible to do what. This involved setting project objectives, and then scheduling a course of action for Step 2.

In Step 2 the first objective was to define NAVEDTRACOM requirements in the planning area. The DOTS Phase I analysis, completed in December 1973 when CNET was a newly created command, was reviewed and updated. This analysis identified

[3]Excerpt from Address by RADM A. Sackett, Pensacola, FL - 1974

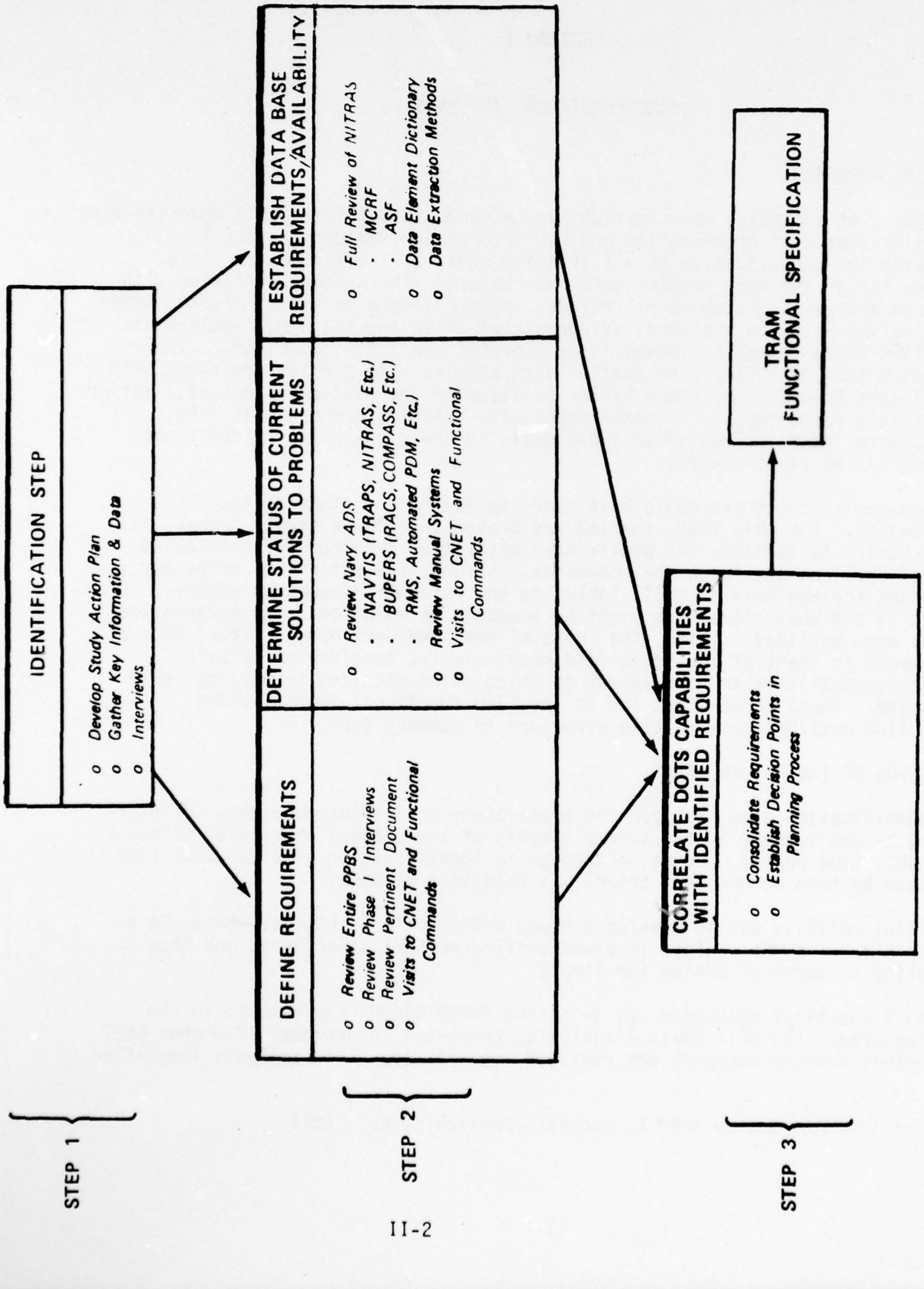

FIGURE II-1 TRAM FUNCTIONAL SPECIFICATION TASKING STRUCTURE

demands placed on CNET by other commands, and demands placed by CNET on its functional commands.

The second objective was to determine the status of current solutions to planning problems. CNET appears successful in conducting its business; therefore this objective was to provide an understanding of how their business process operates, and how current and planned information systems support it.

The third objective was to establish the status of current and planned automated data processing systems. This information was to provide an understanding of the current support given, point out the direction in which this support is going, and to allow development of a system with minimum data requirements while avoiding overlapping or duplication of functions.

The objective of Step 3 was to correlate the existing DOTS capabilities with identified requirements. The overriding objective of the DOTS project is the application of mathematical modeling to the solution of problems within the training command. To provide maximum utility with minimum expense, it is obvious that any new model should draw heavily on the expertise and knowledge gained in previous efforts. It was then decided that the functional specification to be developed should not delve into entirely new technologies or into different areas than those already explored.

Based on these objectives, the team was assigned tasks, a schedule and management support plan were developed, required data were requested, and trips to CNET and the functional commands were scheduled.

CNET ANALYSIS

The TRAM study initially centered on CNET. The key persons interviewed were Mr. B. C. Monnes (CNET N-301), CAPT W. H. Mayer (CNET N-6), CAPT J. R. White (CNET N-31) and CDR E. S. Baker (CNET N-73). The CNET portion of this analysis was also coordinated with Dr. L. R. Mac Keraghan and Mr. E. O. Moore of TAEG, to assure the analysis did not duplicate the Navy Training Plan Process Study team efforts and to gain the benefit of their knowledge and expertise.

Discussions with CNET centered around a higher level of planning than had been encountered on earlier visits. In its simplest form the basic problem facing the planning function in CNET is the fact that training requirements are not, for the most part, generated from within the NAVEDTRACOM, but rather are directed towards CNET by other commands. Usually the resources required to accommodate this training are not passed along with the requirement. As has been detailed in the Phase I report, the Five-Year Defense Program (FYDP) is the normal channel used to obtain the necessary resources. The Program Objective Memorandum (POM) is the vehicle by which CNET makes known to the CNO its unfunded requirements. It was pointed out that new or increased training requirements do not automatically provide the resources required to support those increased requirements. Obviously, as CNET maintains no pool of resources, these required assets can only be obtained through the POM or through internal reprogramming of resources.

One key factor became evident during these discussions that differed from previous ones. In the past, the emphasis was always placed on centralizing the planning process at CNET. Now the emphasis is placed on the Functional Commander's role in this process. The Functional Commanders are now being directed to submit to CNET new resource requests a minimum of 2½ years in advance (5 years for MILCON funds, 4 years for trainers) of the time they are required. The new emphasis is on collecting, correlating, and prioritizing these requirements, with the actual computational and justification effort being expended by the Functional Command. The Mechanized POM being prepared for CNET is the vehicle to be used to accommodate this plan of action.

Thus, after an analysis of CNET's role, it became obvious that the thrust of TRAM should be directed toward the Functional Command level where the detailed analysis and tradeoff studies are conducted. The most obvious candidate for application of the TRAM technology was CNTECHTRA. This command not only operates the bulk of CNET's courses but also conducts planning for A and C Schools for COMTRALANT and COMTRAPAC. Therefore, the remainder of the TRAM analysis centered primarily on CNTECHTRA.

CNTECHTRA ANALYSIS

The plans, programs and facilities at CNTECHTRA are the responsibility of Code N-2. Here, planning for student loads, facilities, major increments and decrements, construction, and personnel (staff and instructors) is carried out. The analysis of this function can be broken into two major divisions - reprogramming and increment/decrement. Reprogramming, in its simplest form, is the adaption of training resources to current needs. Examples of this are shifting instructors from one course to another, or the compromises made to best accommodate Chief of Naval Operations (CNO) training requirements. The increment/decrement process is less operational and more in the category of the traditional "what if." Long-range plans for equipment, personnel, and monies are the resultant of this process. The major difference between this process and the academic posing of questions is that the results quite frequently become fact; therefore, the data used by the planner must be more accurate.

REPROGRAMMING. One of the most frequent day-to-day activities of Code N-2 is the reprogramming process. Reprogramming can be described by the following points:

1. Reprogramming is short-range, and usually does not involve immediate transfer of personnel from one activity to another.

2. Reprogramming does not contain an increment/decrement, per se. Rather, the movement of staff to new jobs is involved, and not the longer range movement of billets.

3. Head-count at an activity rarely goes up or down immediately as a result of reprogramming.

4. Reprogramming is a continuous process. Reprogramming, therefore, represents the refinement of previous plans (or lack thereof) to produce a workable training operation. It is necessary as CNET has no pool of billets or bodies to shift to areas where workload is increasing.

5. The process involves setting a priority on training, and then accommodating as much of the desired load as possible, constrained by available resources. The term "level" was often applied to this process. This meant that resources would not go up appreciably to accommodate new load, and the resources had to be shifted from lower priority training.

The following observations were made during our study of reprogramming:

1. NITRAS was the source of data, listing what a training activity had committed to do. This was in the form of course convenings, lengths, schedules, student/instructor (S/I) ratios, capacities, and the like. Also, student load data, once approved, are placed in NITRAS for the current and out years. This Data Processing (DP) system is the backbone of the NAVEDTRACOM communication concerning student load and course/class availability.

2. Instructor billets are justified based on courses currently in NITRAS, and are subject to audit. The formula for justifying these billets is based on student load and course requirements, and is quite consistently applied.

3. Billets and manpower are two different things. The billet authorizes ctivity personnel, but does not provide them. Actual manning may be igher or lower, but almost always is somewhat lower than authorized. n the reprogramming process, manning is somewhat more critical than : is in the increment/decrement process.

4. Costing during the reprogramming process is not usually required. Staff personnel are rarely added or deleted in significant numbers. Reduction in Force (RIF's) or reassignment costs are rarely encountered. Normally, the reprogramming process consists of reassigning current resources within approved budgets.

5. The reprogramming process is not oblivious to long-range planning. In fact, it is hard to draw a line where reprogramming leaves off and more academic planning begins.

The analysis of reprogramming is applicable to a TRAM type model. The data sources for this planning include:

1. Navy Integrated Training Administration System (NITRAS)
2. Chief of Naval Operations (CNO) Input Requirements
3. Training Requirements and Planning Subsystem (TRAPS) Model
4. Manpower Authorizations (1000/2) Billets
5. Civilian Ceiling Points
6. Manning Levels

Items 1, 2, 4 and 5 are inputs to the TRAM model. Item 3, TRAPS, is currently undergoing major revision and the study of this system was dropped. This was due to the fact that the TRAPS logic depends on the current Navy Enlisted Classification (NEC) system. This NEC system was not designed to aid automated computer planning of student loads, and the results obtained by applying computers

to this process are somewhat inconsistent. The multiple paths to a NEC make the computer logic difficult and inefficient. Thus, the results of a manual TRAPS analysis are used as an input to the TRAM model. The remainder of the data elements consistent with reprogramming will be discussed in the model design section of this report.

INCREMENTS/DECREMENTS. The other major process studied at CNTECHTRA was the increment/decrement process. In general, this can be broken into two finer subdivisions, "what if's," and actual increment/decrement submissions. The "what if's" as described are those short-fuse questions, the answers which aid a higher echelon in a decision process, but the results of which must be refined prior to implementation should that occur. Rules-of-thumb and averages or percentages are used rather than identifying the actual billets to be cut, or spelling out each piece of equipment to be moved. The questions asked in this process are usually not overly complex as the answers would be too time-consuming and expensive to produce. The data required to study these general "what if's" are as follows:

1. NITRAS, for Training Load and Courses
2. 1000/2 Billets
3. Civilian Ceiling Points
4. Resource Management System (RMS) Cost Data

All four of these were available in bulk form (data processing) and were made available for the TRAM Model. The logic used in running these "what if" questions is detailed and considered within the scope of the TRAM capabilities.

The second portion of this increment/decrement process is the construction of a formal study or report. The questions posed and the results appear similar, but there are important differences. Rules-of-thumb are used only in the total absence of data from any other source. A telephone call to obtain exact information, such as shipping charges, replaces averages. A manual analysis of the 1000/2 forms replaces tying personnel to percentages, or other linear techniques. In general, as the number of data sources increases significantly, the detail of the study is magnified, and the logic involved varies with each study. All three of these factors currently make a computer replacement of this process infeasible. It was determined that at best TRAM could assist in portions of this more detailed increment/decrement analysis.

In summary, the study of CNTECHTRA resulted in the following conclusions pertinent to TRAM:

1. Student loads, as obtained from CNO, drive CNTECHTRA; presently, CNTECHTRA has insufficient influence in this planning process.

2. Reprogramming is the short-term process of reassigning current resources; increment/decrement refers to longer range acquisition or use of resources. However, a major part of this latter process involves considerable reprogramming to be effective.

3. The TRAM model should be able to assist in answering "what if's" in the area of short-term planning or reprogramming. The data sources are available in bulk form, and for many of the "what if's" the logic used in the decision process is straightforward and amenable to automation.

4. "What if's" in the increment/decrement process are applicable to TRAM processing, as long as the result is used to study the implications of a course of action and not used as the end result of the study. Total automation is not possible as: (a) several factors, such as equipment costs and construction costs, must be figured on an individual basis; (b) the logic used in determining the desirability of a course of action may differ; (c) data come from several sources, depending on the specifics of the plan under study. Based on this, suggestions such as provisions for manual entry of off-line data were dropped in lieu of a more concentrated effort in providing a model that would calculate the implication of a course of action.

SECTION III

TRAM MODEL DEVELOPMENT

INTRODUCTION

The TRAM model is [illegible] vel, interactive, user-oriented system. The system consists of four ma[illegible] (with numerous subprograms), two major data bases, and one refe[illegible] ase. A front-end program interacts with the user - providing ins[illegible] nd prompting - requesting input direction in a highly simplified format [illegible] structuring the user inputs in a form to cause the model program to respond to a relatively complex structured "what if" type question. The types of user questions to which the model can respond deal with incrementing, decrementing, and consolidating training courses and training activities. An abbreviated extract of the Navy Integrated Training Administrative System (NITRAS) Master Course Reference File (MCRF) is referred to by the model to obtain course related data. An instructor computation program operates upon the NITRAS course level data to determine the change in instructor requirements resulting from the "what if" action. Changes in instructors as well as changes in Average-on-Board (AOB) are passed to an interface program which calls upon a cost subroutine to compute total billet/ceiling point changes for each activity affected, to calculate the Military Pay, Navy (MPN) and Operations and Maintenance, Navy (O&MN) deltas, and to print a resource change summary resulting from the "what if" action. During this process, reference is made to the second major data base containing billet/ceiling point and cost data by activity.

This section of the report presents the detail of the model development effort growing out of the functional analysis covered in Section II. It outlines the model by major program, describes the functional specification upon which model design and development was based, and discusses important data considerations in the creation of model default routines.

TRAM MODEL DESCRIPTION

Four major programs comprise TRAM. They are shown in Figure III-1 as 1) PGM PARAM, 2) PGM TRAM, 3) PROGRAM ICALC and 4) PGM IFACE (or IFACEI). The two key data bases are 1) NITRAS MASTER and 2) NUIC, XUIC and PCOST MATRIX. The reference data is labeled NITRAS TABLES. Following are descriptions of these major model components as well as of the other programs, executives, data bases, and reports shown in Figure III-1.

PGM PARAM. This program provides the major interaction between the system user and the TRAM model. This FORTRAN language program requests required input from the user, such as years of consideration, default characteristics, etc., provides a menu of options available, and in a conversational mode allows the non-ADP oriented user to set up a complex model run. Keywords such as QUIT, HELP, ?, DONE, and FIN are recognized at all times throughout this operation to guide the model user with minimal data input/output. Prompting is provided if a response is incorrect, and the entry HELP or ? will provide a message detailing the information required. Three major option menus are provided: DECREMENT, INCREMENT, and CONSOLIDATIONS. Decrement specifies those courses that are to be deleted; Increment specifies those courses where loads or lengths are to be

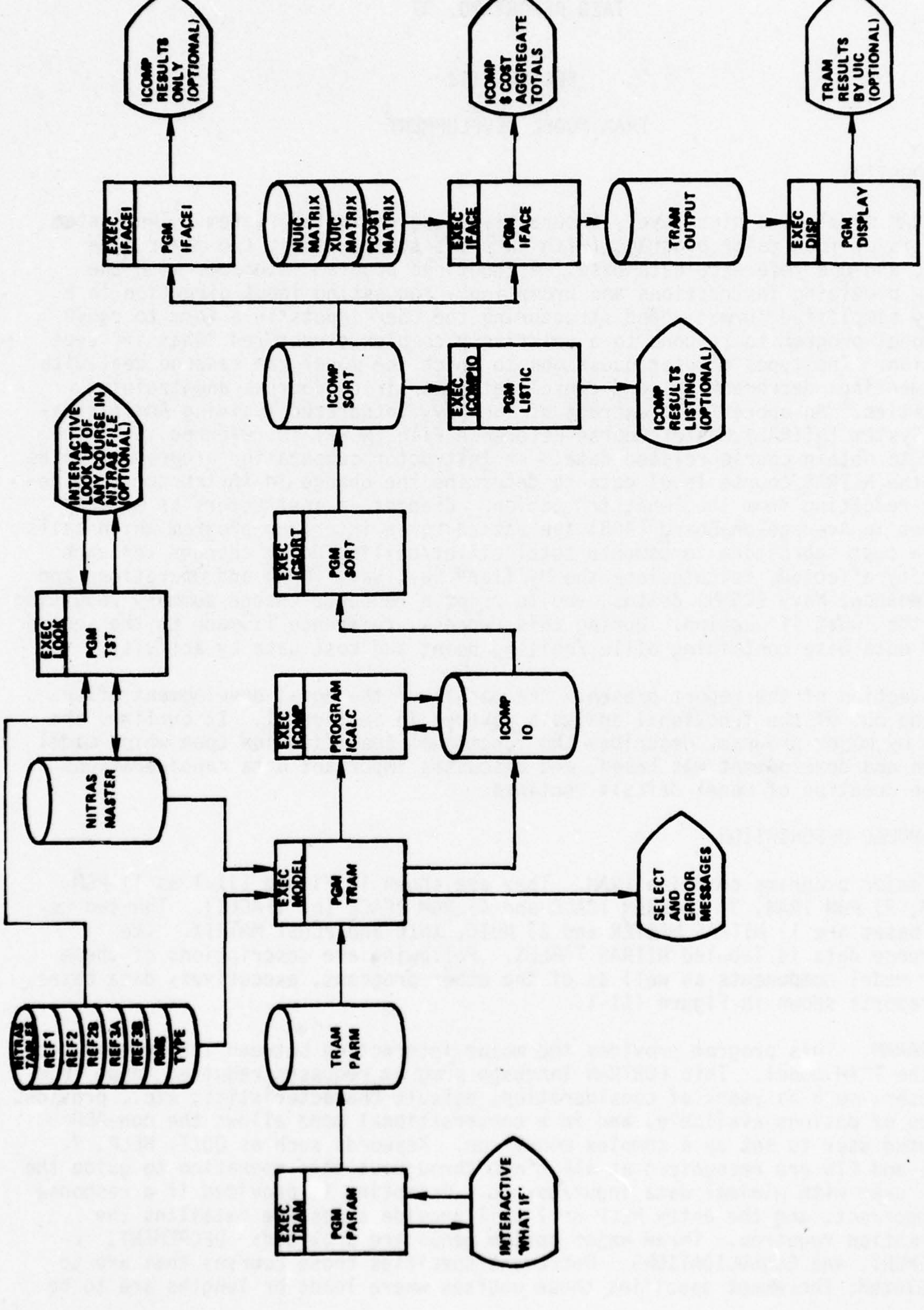

FIGURE III-1 TRAM ON-LINE SYSTEM OVERVIEW

modified; Consolidation specifies courses that are to be moved from one location to another and consolidated with existing courses at the new location. Sub-menus are provided to aid in selection of the actual courses to be involved in one of the above three actions. The first sub-menu allows selection of all courses for a UIC, or just a portion of the courses. The second sub-menu allows for selection by CDP, CIN, RMS code, or course type. The logic in Program PARAM insures that all data are requested for a desired action, and that invalid options will not be passed on to Program TRAM. Several actions may be requested for a given run. This allows, for example, consolidating all type C courses from Activity A to Activity B, and all $ type F courses from Activity A to Activity C in one run for evaluation. The resultant of Program PARAM is a group of control parameters written to file TRAM PARM that will control the TRAM model execution.

Program TRAM is called to execution by executive TRAM, which is initiated when the term 'TRAM' or 'TRAM I' is entered on the NCSS terminal. From this point on, execution of the system is under program control, with all necessary interaction by the operator preceded by a descriptive PROMPT. The entry of 'TRAM' will cause execution of the entire TRAM system, while the entry 'TRAM I' will cause execution of the system to terminate following printing of the summary of the instructor computation results, bypassing the cost calculation.

It should be noted that file TRAM PARM, that is created by Program PARAM, could be set up manually for non-interactive operation of the TRAM system in the batch mode.

PGM TRAM. This Fortran Language program is the heart of the TRAM system. The basic purpose of this program is to first, analyze the parameters transmitted from Program PARAM; second, access the courses indicated by these parameters from the NITRAS master; third, make the necessary actions and modifications as indicated by these parameters; and finally, write an output file so that program ICALC can analyze the net effect on instructor requirements.

The logic of Program TRAM is as follows. First, seven NITRAS reference tables are read in. These tables allow access of any course in the NITRAS file by certain combinations of staff UIC, student UIC, CIN number, CDP number, RMS code, or course type. Next the parameter file from Program PARAM is read and analyzed. Incorrect inputs, such as invalid UIC codes, are flagged at this time. Then the proper action is taken. If the courses are decrements, they are written to file ICOMP IO as a decrement. If the courses are increments, they are written first to the file 'AS IS' as decrements, then the requested modifications are made, and they are written as increments. This method allows the total instructor requirements, and the net change caused by this action, to be determined. Consolidations are somewhat more complex. Basically, all courses involved in a consolidation are first written as a decrement, whether at a 'TO' or 'FROM' location. The loads are then allocated to the receiving locations. If the same courses exist at the receiving locations, they are expanded to handle the increased load. If the course does not exist, it is established at the first receiving location. The modified courses are then written as increments, again allowing computation of total and delta instructor requirements. Many such actions can be cascaded; Program TRAM cycles until all such actions have been disposed of. Program TRAM is called by Executive MODEL. No entry is normally required to start this executive, as it is automatically called by Executive TRAM.

PROGRAM ICALC. This PL1 program accepts the NITRAS and calculated data from PGM TRAM for each affected course, and calculates the changes in instructor requirements resulting from the user input request. A major facet of this program is the application of default options to handle missing data situations in the NITRAS data base. The analyses leading to the establishment of default values are discussed later in this section.

PGM ICALC is called by ICOMP EXEC automatically. No user intervention is required.

PGM IFACE (and IFACEI). This FORTRAN program accepts a sorted output of PROGRAM ICALC and develops an interface table for a COST SUBROUTINE. These interface data include the activity UIC, delta instructors and AOB, any shortfall in training capability due to lack of capacity at an activity, and the year to be considered. IFACE EXEC calls PGM IFACE which in turn calls COST SUBROUTINE. This FORTRAN subroutine calculates officer and enlisted, instructor and support personnel, as well as civilians incremented or decremented by activity. MPN and O&MN dollars are calculated and an output report is prepared which summarizes the changes in resources from the user-specified action. A TRAM OUTPUT file is created which contains detailed reports for each UIC affected. These detail reports can be accessed through PGM DISPLAY when the user invokes the DISP EXEC by entering the term 'DISP'.

PGM IFACE is invoked automatically using IFACE EXEC. The user has the option of bypassing the cost calculations by entering TRAM I and MODEL I in place of TRAM and MODEL which were previously discussed. When this alternative procedure is followed, IFACEI EXEC will be used to call PGM IFACEI. Only the results of the instructor computations will be presented under this option. No costs will be calculated.

NITRAS MASTER. This data base contains over 4100 records extracted from the Navy's NITRAS Master Course Reference File. Each record contains 247 fields of data which describe each of the approximately 4000 courses taught by CNET. Some non-CNET courses are also described in this file. PGM TRAM accesses the data in NITRAS MASTER in responding to the user initiated increment, decrement, or consolidation requests. The data stored in this file are listed in Figure III-2.

NUIC, XUIC, PCOST MATRIX. This file contains three separate matrices which are accessed by PGM IFACE during the resource calculation process. The UIC Matrix (NUIC) contains billet (enlisted, officer, and student) and civilian ceiling point data for each CNET UIC. The data contained in this file are outlined in Figure III-3. The Exception UIC Matrix (XUIC) contains a list of UIC's which require special handling during the resource calculation. Special process directing flags, as well as information contained in the output reports, are included in this file. Its contents are described in Figure III-4. The Personnel Cost Matrix (PCOST) contains standard cost factors used in the final resource calculation; its content is listed in Figure III-5.

NITRAS REFERENCE TABLES. Seven tables are read-in by program TRAM. These tables are used to provide access to specific records in the NITRAS file without the necessity of reading all 4100 plus courses in the file. Thus, a decrement of all C7 courses can be accomplished by merely looking in a core

NITRAS MCRF EXTRACT FORMAT

Page 1

RECORD POSITION	DATA NAME	LEN	TYPE	M/O	VALUE/COMMENTS
1–4	CDP	4	AN	F1	
5–12	CIN	8	AN	F1	
13–28	COURSE SHORT TITLE	16	AN	F1	
29–32	NOBC	4	AN	F1	
33–36	NEC	4	AN	F1	
37–39	OFF. CRS. CODE	3	AN	F1	
40–44	PRIORITY DES	5	AN	F1	
45–48	RMS COST CODE	4	AN	F1	
49–50	TYPE COURSE	2	AN	F1	
51	SVC SUPP	1	AN	F1	
52	METHOD INST.	1	AN	F1	
53–67	FILLER	15	AN	F1	
68	DEPT–CODE	1	AN	F1	
69–71	FILLER	3	AN	F1	
72	STATUS–CODE	1	AN	F1	
73–75	STATUS–DATE	3	P	F2	S9(5) COMP–3
76–83	PREREQ–CIN	8	AN	F3	
84–85	EST. ATTR. RATE	2	P	F4	S99V9 COMP–3
86–87	EST. SETBK. RATE	3	P	F5	S99V9 COMP–3
88–90	THEORY HRS.	3	P	F6	S9(5) COMP–3
91–93	LAB HRS.	3	P	F7	S9(5) COMP–3
94–96	FILLER	3	AN	F8	
97	TRAPS IND.	1	AN	F8	
98–102	TPC	5	AN	F8	
103–107	STU. UIC	5	AN	F8	
108–112	STAFF UIC	5	AN	F8	
113–140	CRS CONTACT HRS	28			
(7x)	CONTACT RATIO	2	P	F9A(7)	S99 COMP–3
	CONTACT HOURS	2	P	F9B(7)	S999 COMP–3
141–143	TOTAL CONT HRS	3	P	F10	S9(5) COMP–3
144	CFY–CROSS UTIL	1	AN	F11A	
145–147	CFY–CRS LENGTH	3	P	F12	S9(5) COMP–3
148–150	CFY–CLASS FREQUENCY	3	P	F12	
151–153	CFY–PERS INPUT	3	P	F12	
154–156	CFY–PERS FREQ	3	P	F12	
157–159	CFY–EQUIP INPUT	3	P	F12	
160–162	CFY–EQUIP FREQ	3	P	F12	
163–165	CFY–SPACE INPUT	3	P	F12	
166–168	CFY–SPACE FREQ	3	P	F12	
169–183	FILLER	15		F11B	

FIGURE III-2

NITRAS MCRF EXTRACT FORMAT

Page 2

RECORD POSITION	DATA NAME	LEN	TYPE	M/O	VALUE/COMMENTS
184–223	FY+1 CAPACITIES				same as Col. 144–183
224–263	FY+2 CAPACITIES				same as Col. 144–183
264–266	CFY OF PLAN–USN	3	P		S9(5) COMP–3
267–269	CFY OF PLAN–USNOB	3	P		
270–272	CFY OF PLAN–USNR	3	P		
273–275	CFY OF PLAN–USNRR	3	P		
276–278	CFY OF PLAN–USMC	3	P		
279–281	CFY OF PLAN–USCG	3	P		
282–284	CFY OF PLAN–USA	3	P		
285–287	CFY OF PLAN–USAF	3	P		
288–290	CFY OF PLAN–NATG	3	P		
291–293	CFY OF PLAN–FORNAT	3	P		
294–296	CFY OF PLAN–DOD	3	P		
297–299	CFY OF PLAN–NDOD	3	P		
300–302	CFY OF PLAN–WOM	3	P		
303–341	CFY EN PLAN	39			These fields are all formatted the same as CFY OF PLAN *in Col. 264–302* (13 · S9(5) COMP–3)
342–380	FY+1 OF PLAN	39			
381–419	FY+1 EN PLAN	39			
420–458	FY+2 OF PLAN	39			
459–497	FY+2 EN PLAN	39			
498–536	FY+3 OF PLAN	39			
537–575	FY+3 EN PLAN	39			
576–614	FY+4 OF PLAN	39			
615–653	FY+4 EN PLAN	39			
654–692	FY+5 OF PLAN	39			
693–731	FY+5 EN PLAN	39			
732–770	FY+6 OF PLAN	39			
771–809	FY+6 EN PLAN	39			
810	FILLER				

FIGURE III-2 (Cont'd)

UIC MATRIX FORMAT

RECORD POSITION	DATA NAME	LEN	TYPE	VALUE/COMMENTS
1–5	PARENT UIC	5	AN	
6–10	ACTIVITY UIC	5	AN	
11–15	STUDENT UIC	5	AN	
16–41	ACTIVITY NAME	26	AN	
42–45	CFY TOTAL OFFICER BILLETS	4	I	
46–49	CFY OFF INSTRUCTOR BILLETS	4	I	
50–53	CFY TOTAL ENLISTED BILLETS	4	I	
54–57	CFY ENL INSTRUCTOR BILLETS	4	I	
58–61	CFY CIVILIANS	4	I	
62–65	FY1 TOTAL OFFICER BILLETS	4	I	
66–69	FY1 OFF INSTRUCTOR BILLETS	4	I	
70–73	FY1 TOTAL ENLISTED	4	I	
74–77	FY1 ENL INSTRUCTOR BILLETS	4	I	
78–81	FY1 CIVILIANS	4	I	
82–85	CFY OFF STUDENT BILLETS	4	I	
86–89	CFY ENL STUDENT BILLETS	4	I	
87–93	FY1 OFF STUDENT BILLETS	4	I	
94–97	FY1 ENL STUDENT BILLETS	4	I	
98–103	CFY AOB	6	I	
104–109	FY1 AOB	6	I	
110–113	MULTIPLIER (INSTR COMP ADJ)	4	F4.1	999V.9(decimal assumed)
114–122	CFY CIVILIAN LABOR BUDGET	9	I	
123–131	CFY TOTAL O&MN BUDGET	9	I	
132–140	CFY REIMBURSABLES BUDGET	9	I	
141–149	FY1 CIVILIAN LABOR BUDGET	9	I	
150–158	FY1 TOTAL O&MN BUDGET	9	I	
159–167	FY1 REIMBURSABLES BUDGET	9	I	
168	FLAG1	1	I	
169	FLAG2	1	I	
170	FLAG3 - DETACHMENT	1	I	
171	FLAG4	1	I	
172	FLAG5	1	I	
172–176	PER CAPITA DIRECT MIL PERS	4	I	
177–179	PER CAPITA DIRECT CIV PERS	3	I	
180–187	PER CAPITA DIRECT OTHER COSTS	8	I	
188–191	PER CAPITA ACTY SUP MIL PERS	4	I	
192–194	PER CAPITA ACTY SUP CIV PERS	3	I	
195–202	PER CAPITA ACTY SUP OTHER COSTS	8	I	
203–206	PER CAPITA HOST SUP MIL PERS	4	I	
207–209	PER CAPITA HOST SUP CIV PERS	3	I	
210–217	PER CAPITA HOST SUP OTHER COSTS	8	I	
218–221	PER CAPITA DIRECT TRNG MIL PERS	4	I	
222–224	PER CAPITA DIRECT TRNG CIV PERS	3	I	
225–232	PER CAPITA DIRECT TRNG OTHER COSTS	8	I	
233–236	PER CAPITA SUPPORT MIL PERS	4	I	
237–239	PER CAPITA SUPPORT CIV PERS	3	I	
240–247	PER CAPITA SUPPORT OTHER COSTS	8	I	

FIGURE III-3 NUIC MATRIX DATA ELEMENTS

EXCEPTION UIC MATRIX FORMAT

RECORD POSITION	DATA NAME	LEN	TYPE	VALUE/COMMENTS
1–5	EXCEPTION UIC	5	AN	
6–7	NUMBER UIC'S TO CONSIDER	2	I	
8–12	OTHER UIC'S TO CONSIDER NO. 1	5	AN	
13–52	OTHER UIC'S TO CONSIDER NO. 2–9	40	AN	5 Pos. per UIC Field
53	EXCEPTION CODE FLAG NO. 1	1	I	See Below
54–57	EXC CODE FLAGS 2–5–GENERAL UIC FLAGS	4	I	See Below
58	EXCEPTION CODE FLAG NO. 6	1	I	See Below
59–66	EXC CODE FLAGS 7–14–FOR OTHER UICS TO CONSIDER FIELDS (9)	9	I	See Below
67–124	COMMENTS	58	AN	

EXCEPTION CODE FLAGS

1–0 Follow normal processing. If IPUIC=IAUIC, then all activities with same PUIC (including DETS) will be summed and operated upon as a single unit.

1 Causes Exception Code Flag 2 to be checked.

2–0 Causes activities, where PUIC=AUIC which would normally be summed for all equal PUIC's, to be treated as a single activity. Summing of equal PUIC's would not be performed.

1 Causes FLG3 in the NUIC MATRIX to be checked during the summing of all equal PUIC's. DETS with FLG3=1 will not be included in the summing process. The objective is to sum only those UIC's physically located at one site.

3–5 Additional flags for controlling general process logic sequencing. These are unused at the present time.

6–14 These nine flags are intended for assignment to each of the nine possible UIC's in the 'TO BE CONSIDERED' fields of the XUIC MATRIX. They may be used to designate a UIC as a Host, DET, etc. They are unused at the present time.

FIGURE III-4 XUIC MATRIX DATA ELEMENTS

PERSONNEL COST MATRIX

RECORD POSITION	DATA NAME	LEN	TYPE	VALUE/COMMENTS
1-5	COST/OFFICER BILLET	5	I	24000 FY77
6-10	COST/ENLISTED BILLET	5	I	11000 FY77
11-15	COST/STUDENT BILLET	5	I	None Available
16-20	COST/OFFICER STUDENT BILLET	5	I	24000 FY77
21-25	COST/ENLISTED STUDENT BILLET	5	I	11000 FY77
26-30	TRAVEL COST/OFFICER	5	I	03007 FY77
31-35	TRAVEL COST/ENLISTED	5	I	02221 FY77
36-40	COST/CIVILIAN CEILING POINT	5	I	19000 FY77
41-45	COST/RIF	5	I	09300 FY77
45-50	TRAVEL COST/CIVILIAN CP	5	I	06000 FY77
51-80	NOT USED	30	I	ZERO'S

FIGURE III-5 PCOST MATRIX DATA ELEMENTS

resident table for the location of all courses in the file meeting this criterion (in this case, 37 courses). This greatly reduces I/O, increases speed, and reduces cost of model execution by several magnitudes. Also, to save computer I/O execution costs, these tables are read into the core using unformatted I/O.

OTHER PROGRAMS. Several auxiliary programs and executives were developed to make the model generated information more accessible to the user. The LOOK EXEC and PGM TST have been provided so that the user can review specific courses of interest in the NITRAS MASTER file. Access is provided by CDP, CIN, Staff or Student UIC.

The ICOMPIO EXEC and PGM LISTIC allow the user to create a listing of the instructor computations from PGM ICALC for each course (CDP) involved.

The DISP EXEC and PGM DISPLAY are used to access the detail level reports created from the COST SUBROUTINE within PGM IFACE. The user enters the term 'DISP' to invoke this program after which individual pages or UIC reports can be selected.

TRAM FUNCTIONAL SPECIFICATION

Preliminary functional specifications were developed and evaluated with CNTECHTRA and TAEG in the December 1975 to April 1976 period. Section II of this report described the steps in the functional analysis leading to the Functional Specification. The specification became the framework for the TRAM design and development phase. However, a number of compromises had to be made because of the availability and nature of the data planned as a TRAM input. Some of the compromises, however, were offset by more thorough analyses of the data, which permitted defaults for missing data to be incorporated into the model. The following outlines the general functional specification for TRAM.

OBJECTIVES. The TRAM model is to be a high level system designed to rapidly assess resources attached to increments, decrements, feasibility studies, and/or Program Budget Decisions (PBD) at the Functional Command or CNET level. The thrust of the TRAM model will be to merge the technologies of previous models and develop a new model for resource planning and management. TRAM will test the concept of providing information for advanced planning of available resources required to meet training demands, for the next fiscal year and the several "out years", on an aggregate level or individual course basis. The model will test the feasibility of meeting planned training loads with available resources, calculate resources required to meet shortfalls, indicate resource surpluses, and aggregate these totals on a training center (UIC) basis. The training manager will receive an indication of the problem areas and overall effectiveness of this application of resources through the initial run(s) of the TRAM model. The user can then test the effect of new or modified strategies through additional model runs. A major thrust of the TRAM effort will be aimed at the portion of the model that permits the baseline conditions to be modified to simplify the user/model interface.

PROPOSED METHODS AND PROCEDURES. The TRAM model is intended for use by training management and staff personnel at the Functional Command or CNET level in

order to seek more optimal use of training resources in the accommodation of requested training loads. The personnel using the model, and the specific conditions under which it will be used, will vary. However, the following generalizations can be made.

1. **Decision points where the model may be used.** The following primary decision points, as outlined by CNTECHTRA, indicate various key points in their planning process where the TRAM model might prove useful.

   a) Requirements Planning

      o Increment/decrement planning

      o Development and integration of student quotas

      o Analysis of the effects of attrition on the training command

      o Analysis of new programs

      o Evaluation of plans to reduce rate/rating/NEC shortages.

   b) Determination of Annual Training Rate Feasibility, with:

      o Current manpower authorized

      o Current manning load

      o Current equipment/space limitations

   c) Decision Related to Infeasibilities

      o Mix of courses

      o Elimination of courses

      o Reduction in course lengths

      o Optimum trade-offs.

   d) Optimization of Established Programs

      o Cross-utilization of instructors

      o Mix of convening frequency and class size.

   e) Personnel Requirements

      o Instructor requirements

      o Support (non-instructor) requirements

      o Flexibility in meeting peak demands.

f) Activity or Course Consolidations ("what ifs")

2. Typical Management Applications

Training managers are expected to derive a number of benefits from model use. These benefits may be better understood by treating them within the context of potential problems and questions that training managers may use the model to investigate. The overriding expected benefit is to improve the utilization of training resources. Some typical input questions to TRAM might be:

a) What is the effect of closing a training center?

To close a training center, the load currently taught at that center must be transferred to other facilities. The model will re-program students from courses currently taught at that center to the same courses taught at other locations.

The model user must then indicate a disposition, such as noting a training center that must absorb the shortfall or establish the courses not taught elsewhere. The model would then calculate resource requirements and training loads at each of the training centers affected for comparison with baseline conditions. In this way, rapid comparisons can be made for alternate strategies, including the potential benefits in closing a center.

b) What additional resources are required to eliminate a shortage in trainees with a specific NEC?

Typically, BUPERS identifies shortages in a specific NEC and requests a training load that may not be immediately accommodated, so the load is usually spread over several years. Under certain conditions, it is desirable to accommodate this demand in a shorter time period. By indicating the required demand, the model will calculate the resources required to meet this demand, and upon comparison with the baseline, indicate the new resources to meet this peak demand.

3. Primary Inputs

Three primary inputs with a multiplicity of attributes have been defined for the TRAM model.

a) Resource/Capacity/Planned Requirements - This input is directly from the NITRAS MCRF file and includes course numbers, names, capacities, schedules, resource requirements and planned training loads. These data will form the baseline for calculating instructors and support requirements, based on schedules and loads, for courses and training centers.

b) Personnel Data - This input defines authorized billets at each CNET activity for the current and one out year. Data for FY+2 to FY+6 were eliminated for this model due to potential security classification problems. These data are available from the 1000/2 files. Other inputs include civilian ceiling points and personnel from other services serving at a CNET activity.

c) Cost/Resource Data - This input currently comes from data contained in the Per Capita Cost System. It is used to estimate the dollar value applied to model calculations, and to provide some insight into an activity's operation.

4. Primary Outputs

Four model outputs have been defined.

a) Instructor Resources - This output identifies the instructor requirements, on a course basis or aggregated on a training center basis, as calculated using the formulas outlined in CNTECHTRA Instruction 5311.1A, Change 2. These instructor requirements may be based on the course running at (a) planned load, (b) 100% load, or (c) requested but infeasible load.

b) Support Requirements - This output defines the numbers of support personnel required to meet the planned training load and is aggregated by training center (UIC). The values calculated as far as possible will be based on empirical relationships applied at CNTECHTRA, and augmented by data contained in the UIC input.

c) Throughput - This output quantitatively defines student throughput, aggregated by training center or by rating/NEC. This value gives the actual training load that can be accommodated with currently available resources, or the training load that would result should the requested load be accommodated. This throughput is not a projection, but rather is based on planned loads.

d) Resource Sensitivity - This output is available for certain runs and gives the instructor and support requirements of a training center for various levels of loading. It is useful for determining optimum loading and anticipating the effects of increments/decrements.

DATA SUPPORT AND ANALYSIS. TRAM is dependent upon four primary sources of data in order to operate:

1) NITRAS Master Course Reference File

2) 1000/2 Manpower Authorization

3) Civilian Ceiling Points

4) Resource Management System (RMS) Per Capita Cost and Budget Data.

Extracts of Navy data bases containing the above data were requested in April 1976. Certain RMS data requested from CNET were not made availabe due to their potential sensitivity; civilian data were received too late for incorporating into the automated process, therefore they were entered manually from hard copy sources.

NITRAS. A primary source of data for TRAM is NITRAS. An extract of the actual MCRF data was made for 247 fields, which is only a fraction of the data in the MCRF. The layout of the data extracted was shown in Figure III-2. Much analysis of these data was required before it could be used to support a model run. First, a few of the UIC codes were in error or inconsistent, and these were modified. Next, the data were "washed" through several processes to ascertain their compatibility with model processing. This is not to say that the data were bad. Rather, the NITRAS file is designed to support an information processing system, not a TRAM model. In its proper role, if a planned load is not available it should be left blank. However, if it is to be used as a model input, some estimate or default should be used to assure proper model operation. Likewise, a number that may be blatantly wrong in NITRAS may have no material effect, as that field is not used for calculations, while that same error might totally invalidate TRAM results if it is used as an input.

One of CNTECHTRA's primary concerns is to provide enough qualified personnel to teach or instruct its training load. Thus, the primary use of NITRAS was to calculate instructor requirements based on the standard formula, and course characteristics and student loads from NITRAS. Several analyses were made of the NITRAS data to ascertain how effective this automated instructor computation might be and how the validity could be improved. The first problem, and one that recurred with every data source throughout this study was the problem of applying data to applications for which they were not intended. For example, NITRAS carries the course length in days (as AOB is counted in days elapsed, not instructional days) while the instructor computation requires weeks (or fractions). This field had to be converted. The first analysis was to determine "fatal" errors. These consist of errors for which no redundant data exist or defaults cannot be made with any degree of certainty. The types and numbers of errors generated during this analysis are as follows:

NITRAS INVALID AND MISSING DATA

PREVENTING INSTRUCTOR COMPUTATION

NO. COURSES	TOTAL	FATAL	METHOD INSTRUCTION	CONVENING	LENGTH	CAPACITY	DEMAND	HOURS	AS REQUIRED CONVENING
TOTALS FOR ALL COURSES									
4127	1735	262	498	75	19	304	895	866	252
TOTALS FOR CNET COURSES									
3842	1504	212	397	53	14	242	815	652	219

The one element the model cannot correct for is missing planned load data. It was determined that in most cases a zero load indicated this figure was unavailable; thus, the missing data are valid. As can be seen, a surprisingly low number of courses contain "fatal" errors, and it was felt that this was well within acceptable limits.

Next, several analyses were made to determine default and tolerable limit values. The first analysis was to graph course lengths, both to show the range of lengths to be encountered, and to list in general form the validity of the data. See Figure III-6.

Most courses greater than a few days are in multiples of weeks. As courses are listed in calendar days, lengths of 5, 12, 19, 26, 33, ..., describe even-week courses. The graphical presentation shows that the bulk of the courses follow this pattern. However, 23 courses are loaded showing a length of 14 days, indicating a course ending on a Sunday, which is not likely. More likely, the data were loaded incorrectly, and can be compensated for by considering any 12, 13 or 14-day course as a two-week course, and so on. Using this logic, course lengths can be made compatible with model input requirements.

The second analysis was of S/I ratios. Only recently was this field added to NITRAS and loading is not yet complete. An analysis of these S/I ratios is shown in Figure III-7. The implications of this analysis are shown in four graphs, Figures III-8 through III-11. As can be seen, S/I ratios are fairly consistent if courses are separated by type. Three sets of defaults were calculated, based on the results of this study. These defaults are:

NUMBERS OF COURSES VS LENGTH IN DAYS SOURCE NITRAS PAGE 1

LEN | CRSES 100 2CC 300 400 500 600 700

LEN	CRSES
0	(19)
1	(135)
2	(193)
3	(179)
4	(139)
5	(699)
6	(2)
7	(3)
8	(25)
9	(76)
10	(71)
11	(33)
12	(680)
13	(7)
14	(23)
15	(8)
16	(50)
17	(31)
18	(7)
19	(353)
21	(11)
22	(2)
23	(12)
24	(25)
25	(15)
26	(219)
27	(7)
28	(12)
29	(1)
30	(12)
31	(10)
32	(10)
33	(147)
34	(3)
35	(3)
36	(3)
37	(6)
38	(9)
39	(7)
40	(116)
41	(2)
42	(8)
43	(10)
45	(8)
46	(5)
47	(58)
48	(3)
49	(6)
50	(7)
51	(1)
52	(9)
53	(4)
54	(80)
55	(4)
56	(17)
57	(8)
58	(5)
59	(7)
60	(10)
61	(39)
63	(12)
64	(4)
65	(5)
66	(5)
67	(3)
68	(54)
70	(5)
71	(1)
72	(2)
73	(2)
74	(1)
75	(30)
76	(1)
77	(2)
78	(2)
79	(6)

FIGURE III-G

NUMBERS OF COURSES VS LENGTH IN DAYS - SOURCE NITRAS PAGE 2

LEN	CRSES 100 200 300 400 500 600 700
80	(1)
81	(4)
82	****** (38)
84	* (6)
86	(2)
87	(2)
88	(1)
89	** (16)
91	(2)
93	* (6)
94	(5)
96	** (16)
98	* (6)
99	(5)
100	(1)
101	(1)
102	* (7)
103	* (8)
105	(2)
107	(2)
110	*** (18)
112	(1)
113	(1)
114	(5)
115	(1)
117	* (8)
120	(4)
123	(1)
124	** (14)
126	(2)
129	(3)
131	* (11)
133	(4)
136	(1)
138	** (12)
142	(1)
144	(2)
145	* (9)
149	(1)
152	(5)
154	(1)
159	(5)
160	(1)
161	(2)
162	(1)
163	(1)
165	(1)
166	*** (20)
168	(1)
173	* (8)
175	(1)
179	(1)
180	* (11)
182	** (13)
184	(1)
187	(3)
191	(2)
194	(3)
199	(1)
201	(1)
203	(1)
208	(4)
209	(1)
213	(2)
215	(1)
222	(1)
224	(2)
233	(1)
236	(2)
243	(1)
269	(1)
271	(1)
277	(1)
320	(1)
334	(1)
363	(1)
399	(1)

FIGURE III-6 (Cont'd)

SYSOPSIS OF HOURS AND PERCENT AT ALL S/I RATIOS
LOCKSTEP COURSES - SOURCE: NITRAS

A COURSES

S/I	#CRS	TOTHRS	AV HR	PCT
1	3	26	8	0.1
2	6	180	30	0.5
3	8	219	27	0.7
4	33	1948	59	5.8
5	22	1288	58	3.8
6	31	2675	86	8.0
7	4	254	63	0.8
8	33	2293	69	6.8
9	1	28	28	0.1
10	19	674	35	2.0
11	9	1462	162	4.4
12	25	1045	41	3.1
13	4	226	56	0.7
14	0	0	0	0.0
15	16	1741	108	5.2
16	8	790	98	2.4
18	1	21	21	0.1
19	1	570	570	1.7
20	0	0	0	0.0
21	0	0	0	0.0
22	0	0	0	0.0
23	0	0	0	0.0
24	0	0	0	0.0
25	113	17732	156	52.8
26	2	155	77	0.5
30	2	121	60	0.4
35	0	0	0	0.0
38	1	52	52	0.2
40	0	0	0	0.0
45	0	0	0	0.0
50	1	75	75	0.2
55	0	0	0	0.0
70	0	0	0	0.0
75	0	0	0	0.0
80	0	0	0	0.0
99	2	12	6	0.0

C COURSES

S/I	#CRS	TOTHRS	AV HR	PCT
1	107	3644	34	1.4
2	553	39044	70	14.6
3	391	30297	77	11.3
4	640	45997	71	17.2
5	141	9914	70	3.7
6	403	35514	88	13.3
7	16	1255	78	0.5
8	169	16633	98	6.2
9	12	1421	118	0.5
10	108	6278	58	2.3
11	3	88	29	0.0
12	60	5434	90	2.0
13	1	33	33	0.0
14	2	186	93	0.1
15	44	2528	57	0.9
16	14	2070	147	0.8
18	3	530	176	0.2
19	0	0	0	0.0
20	11	832	75	0.3
21	1	33	33	0.0
22	1	40	40	0.0
23	0	0	0	0.0
24	2	1417	708	0.5
25	426	63571	149	23.7
26	0	0	0	0.0
30	4	475	118	0.2
35	1	56	56	0.0
38	0	0	0	0.0
40	0	0	0	0.0
45	0	0	0	0.0
50	1	10	10	0.0
55	0	0	0	0.0
70	0	0	0	0.0
75	1	545	545	0.2
80	0	0	0	0.0
99	0	0	0	0.0

F COURSES

S/I	#CRS	TOTHRS	AV HR	PCT
1	40	366	9	0.6
2	242	4986	20	8.1
3	283	5823	20	9.5
4	355	8691	24	14.2
5	105	2069	19	3.4
6	442	9322	21	15.2
7	13	155	11	0.3
8	189	4954	26	8.1
9	16	296	18	0.5
10	128	2636	20	4.3
11	4	6	1	0.0
12	235	5682	24	9.3
13	2	18	9	0.0
14	12	228	19	0.4
15	41	736	17	1.2
16	36	862	23	1.4
18	11	224	20	0.4
19	3	3	1	0.0
20	22	564	25	0.9
21	13	780	60	1.3
22	2	66	33	0.1
23	1	8	8	0.0
24	5	117	23	0.2
25	473	11726	24	19.1
26	0	0	0	0.0
30	19	488	25	0.8
35	7	317	45	0.5
38	0	0	0	0.0
40	3	140	46	0.2
45	1	3	3	0.0
50	1	4	4	0.0
55	1	82	82	0.1
70	2	6	3	0.0
75	0	0	0	0.0
80	1	5	5	0.0
99	0	0	0	0.0

AGGREGATE

S/I	#CRS	TOTHRS	AV HR	PCT
1	150	4036	26	1.1
2	801	44210	55	12.2
3	682	35339	53	10.0
4	1028	56636	55	15.6
5	268	13271	49	3.7
6	876	47511	54	13.1
7	33	1664	50	0.5
8	391	23880	61	6.6
9	29	1745	60	0.5
10	255	9588	37	2.6
11	16	1556	97	0.4
12	320	12161	38	3.4
13	7	277	39	0.1
14	14	414	29	0.1
15	101	5005	49	1.4
16	58	3722	64	1.0
18	15	775	51	0.2
19	4	573	143	0.2
20	33	1396	42	0.4
21	14	813	58	0.2
22	3	106	35	0.0
23	1	8	8	0.0
24	7	1534	219	0.4
25	1012	93029	91	25.6
26	2	155	77	0.0
30	25	1084	43	0.3
35	8	373	46	0.1
38	1	52	52	0.0
40	3	140	46	0.0
45	1	3	3	0.0
50	3	89	29	0.0
55	1	82	82	0.0
70	2	6	3	0.0
75	1	545	545	0.2
80	1	5	5	0.0
99	2	12	6	0.0

**** AVERAGES FOR ALL CENTERS ****

	S/I	#CRS	TOTHRS	AV HR	PCT
A COURSES	100	345	33587	97	100.0
C COURSES	100	3115	267845	85	100.0
F COURSES	100	2708	61363	22	100.0
AGGREGATE	100	6168	362795	58	100.0

FIGURE III-7

8/31/76
KVB

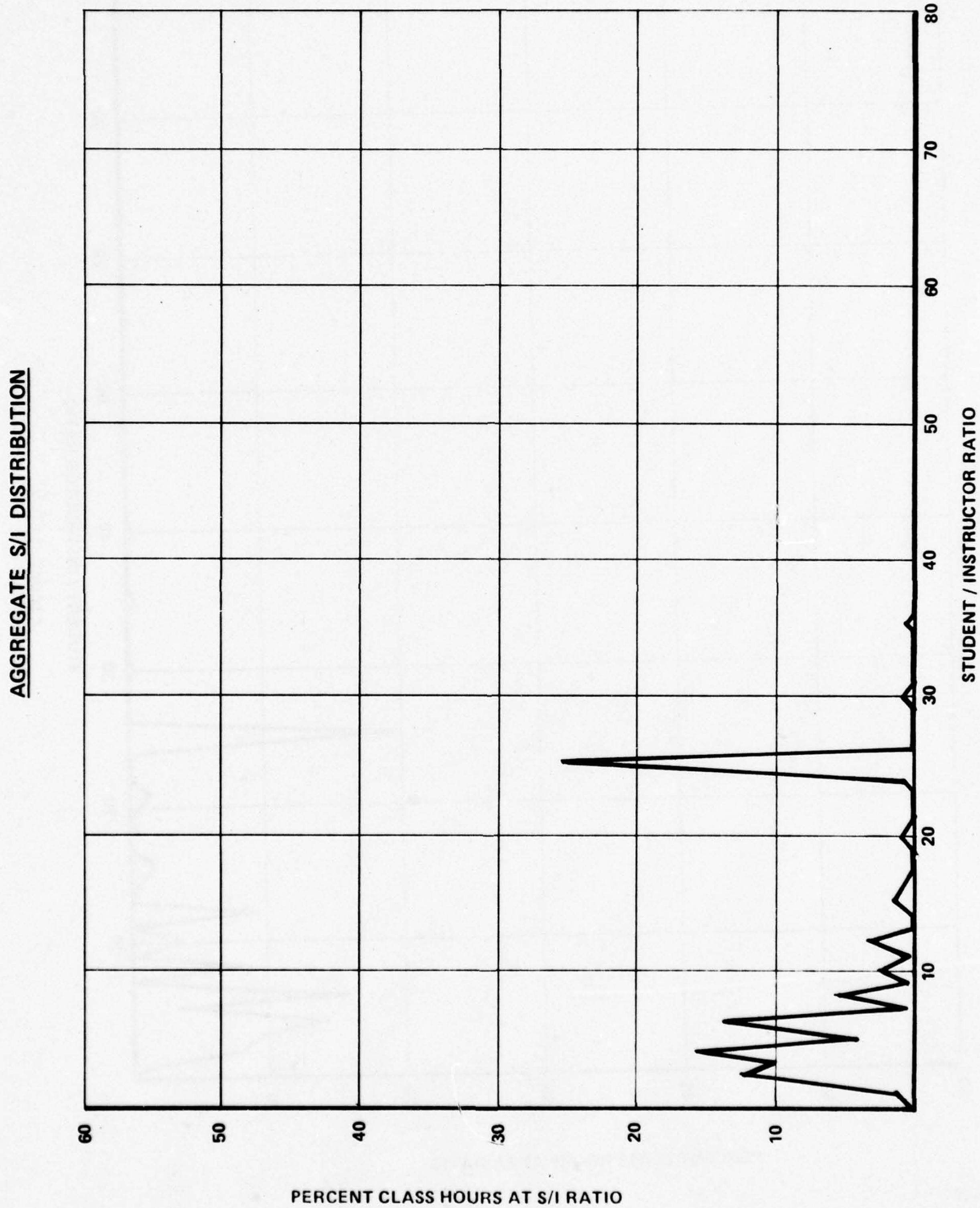

FIGURE III-8

8/31/76
KVB

'F' SCHOOL S/I DISTRIBUTION

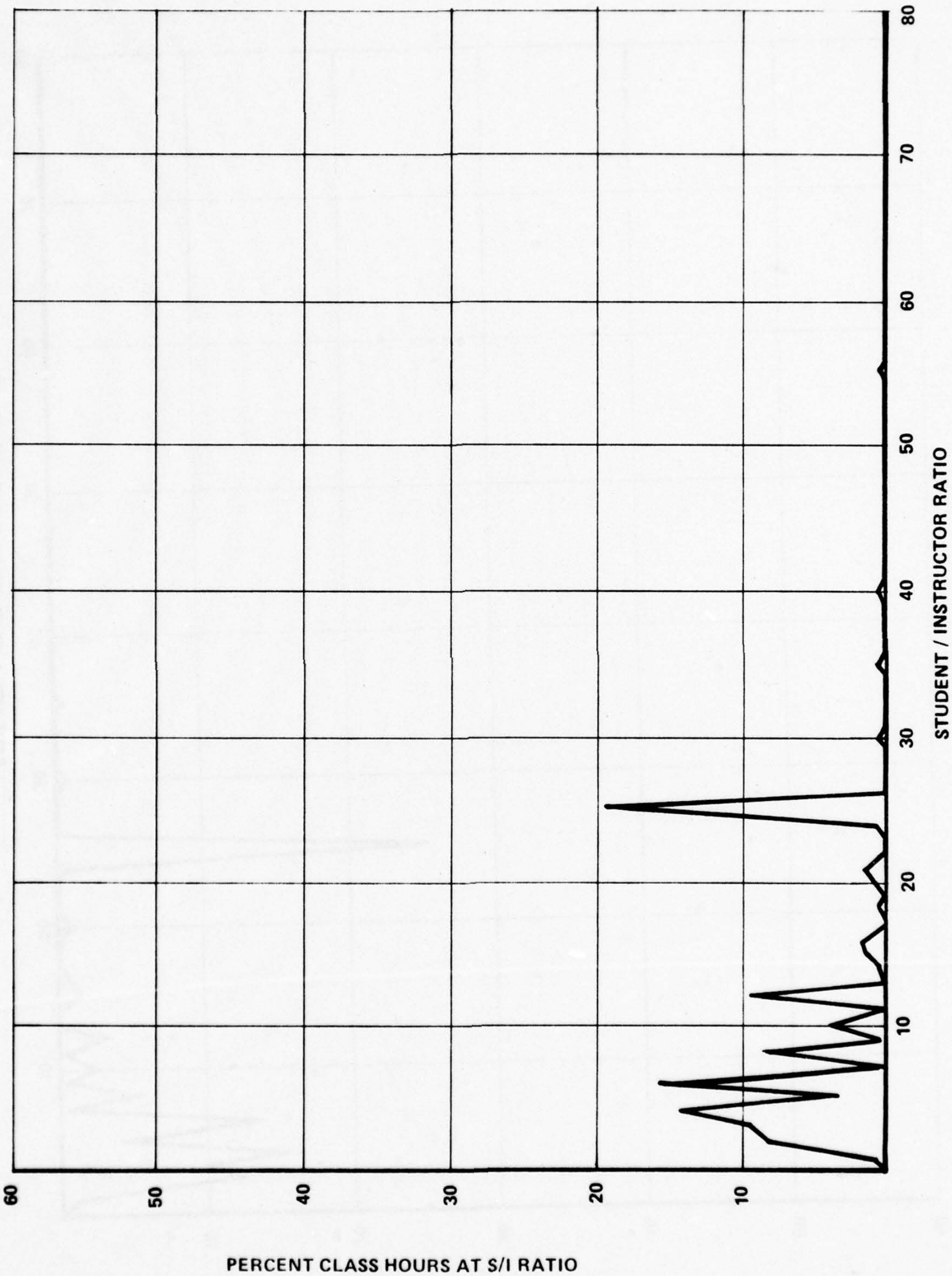

FIGURE III-9

8/31/76
KVB

'C' SCHOOL S/I DISTRIBUTION

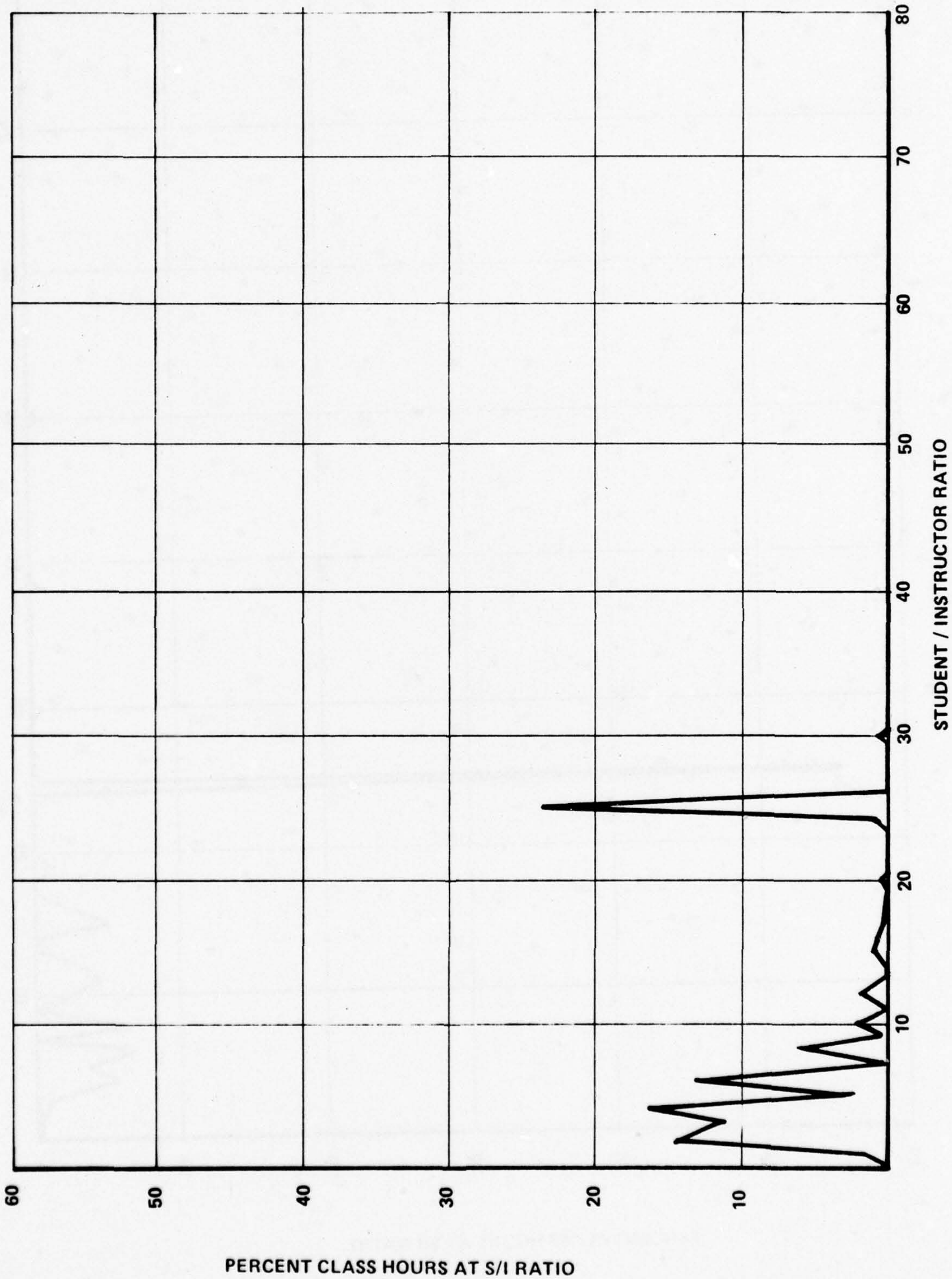

FIGURE III-10

8/31/76
KVB

'A' SCHOOL S/I DISTRIBUTION

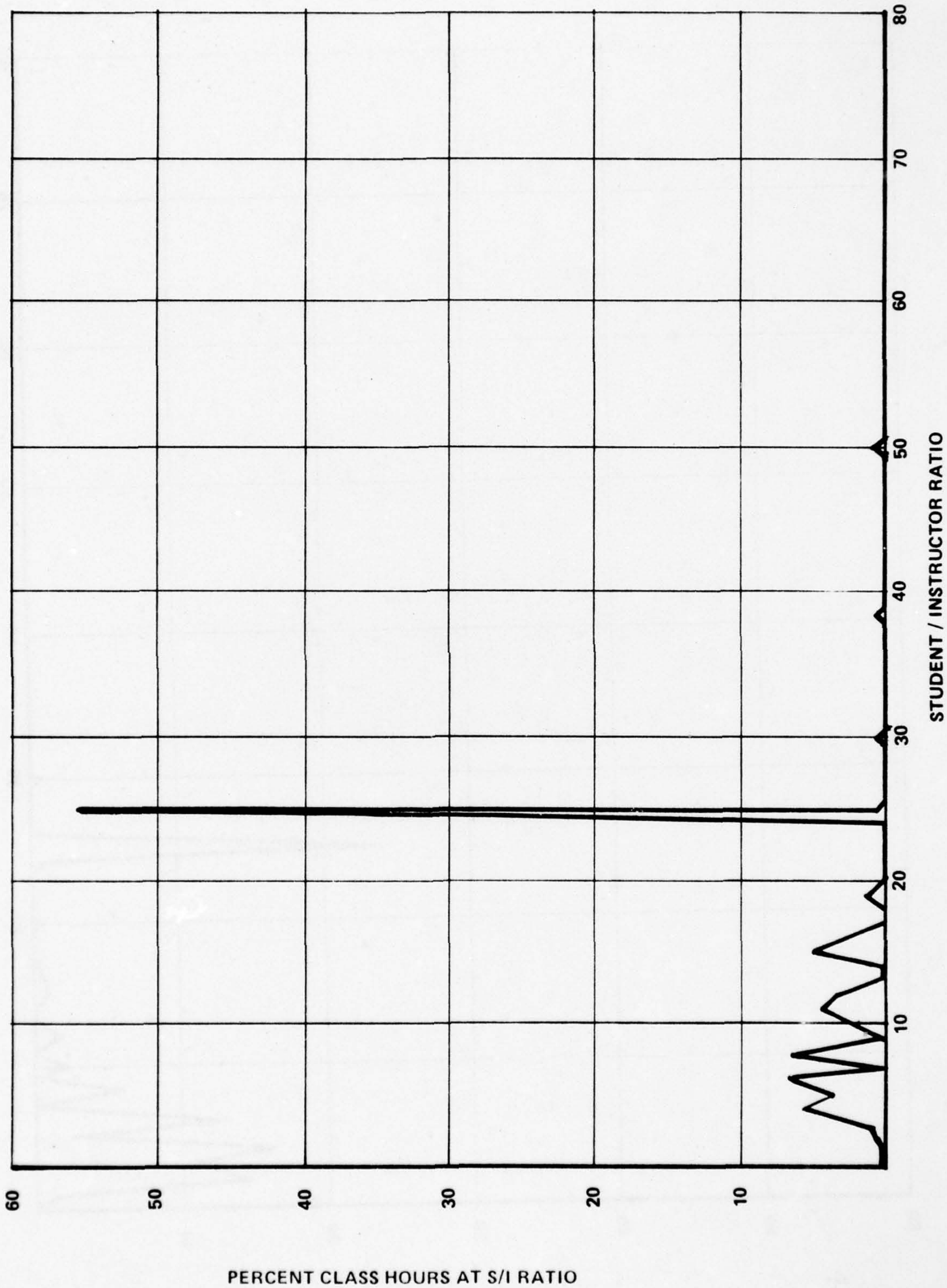

FIGURE III-11

A COURSES		C COURSES		F COURSES	
Ratio	% Hrs.	Ratio	% Hrs.	Ratio	% Hrs.
50	1.3	50	0.4	50	1.8
25	54.6	25	26.6	25	25.2
16	8.3	12	4.8	12	14.2
12	9.6	8	6.7	8	8.5
8	7.5	6	17.0	6	18.7
6	11.8	4	28.5	4	14.3
4	7.0	2	16.0	3	17.3

These default values are slightly raised so that minor course overloads will not result in an excessive number of instructor requirements being generated.

Next, the average length of a teaching day was calculated, and is shown below:

COURSES AT VARIOUS HRS/DAY (LOCK STEP COURSES)

1 - 2	1
2 - 3	9
3 - 4	39
4 - 5	41
5 - 6	238
6 - 7	2205
7 - 8	400
8 - 9	83
9 - 10	22
10 - 11	12
11 - 12	7
12 - 13	11
13 - 14	5
14 - 15	2
15 - 16	2
16 - 17	1
19 - 20	1
26 - 27	1
30 - 31	1
31 - 32	2
35 - 36	1
42 - 43	1
99 - 100	1

AVG HRS/TEACHING DAY = 6.45 NUMBER OF COURSES IN SAMPLE = 2843

The average value, 6.45, was used without further analysis.

Further analysis was made of maximums, minimums, and averages for course lengths, convenings, loadings, etc., to determine norms for model operation and to allow data error detection and correction by use of defaults.

This analysis is too large to be included in this report. The full analysis is contained in the listings section of TAEG Technical Memorandum 76-3.

Based on this analysis, the only data correction made to NITRAS involved the changes in UIC codes described previously.

1000/2 ANALYSIS. The 1000/2 Manpower Authorizations contain the authorized and projected billet information for all activities. The 1000/2 data were extracted for two fiscal years for all CNET activities, deleting most out-year data due to a security classification problem. The format of these data is shown in Figure III-12.

As was the case with other data sources, enough inconsistency existed in data and data formats to substantially complicate the computer processing. First, officer and enlisted files contain slightly different formats, so they cannot be automatically merged. Second, the UIC codes are not totally consistent with NITRAS, complicating an automatic comparison. (The same is true with 1000/2 vs. RMS.) Third, the billet information is not coded in a form that permits a computer to perform a job analysis study. Finally, not all personnal at an activity are included (civilians, Marines, other services, etc.) On the 1000/2 tape, one form of automatic analysis was possible - the determination of instructor billets. Various combinations of searches based on NEC's, NOBC's, and the words INST or INSTR with various leading and trailing characters allowed extraction of instructor billets with a greater than 99% confidence factor. The data extracted included officer and enlisted billets by activity (including average grade), instructor billets (officer and enlisted), and student billets. The results of this detailed analysis are contained in the computer listings of TAEG Technical Memorandum 76-3.

ANALYSIS OF RMS COST DATA. One objective in the development of TRAM was to have the capability of assigning costs to resource deltas calculated during a model run. A magnetic tape detailing costs by RMS cost account was obtained from Code N-5 of CNTECHTRA. The detail cost data were summarized into three major categories for each training UIC. Figure III-13 is an example of a UIC summary and shows the three categories:

1) Command and Staff - Represents cost accounts with a distribution code of 0000100 (OH-1). Generally, only a single detail account contained all of the data in this category. Training Center Command, e.g., C.O., X.O., etc, and Staff, e.g., Personnel, Administration, etc., are included.

2) Support - Contains all non-mission related resources which the activity consumes in support of other base functions, e.g., Public Works, Supply, etc. Cost accounts with distribution codes 0999100, i.e., Excluded Costs less the costs included in the Command and Staff - ACTY SUPPORT category, are contained in this classification.

3) Direct Training - Contains all direct training costs including Division (OH-3) and Department (OH-2) cost accounts. Distribution codes of XXXX7XX (Direct), XXXX500 (OH-3), and XXXX300 (OH-2) are summarized into this category.

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PROPORTIONAL RECORD LAYOUT FORM

Application OFF ENL 1000/2 TAPES Type of Records BLOCKING (10) By K. BRANCH Date 6/17/76 Page 1 of 2

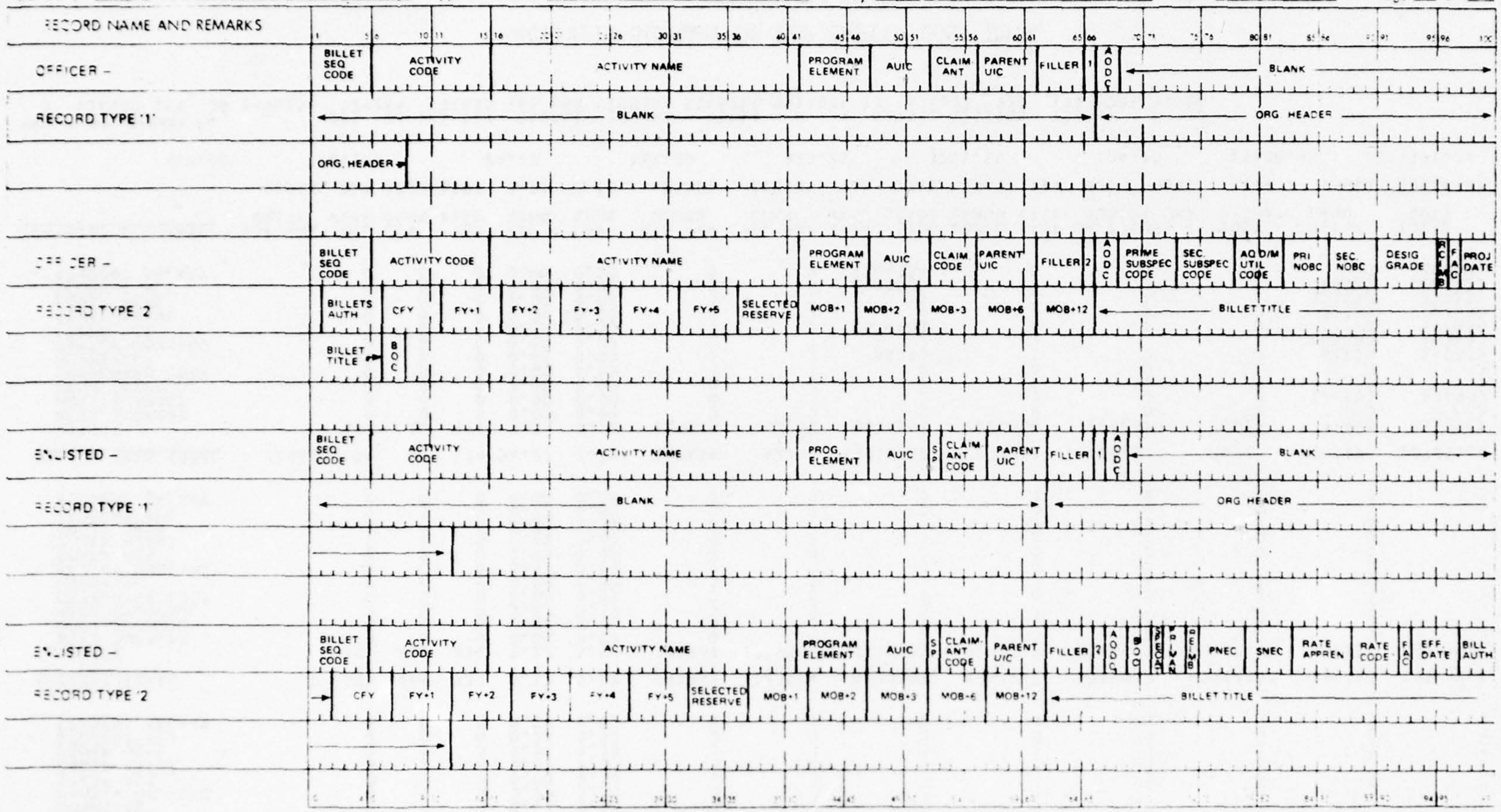

FIGURE III-12

UIC : XXXXX   XXXX XXXXXXX XX   NUMBER RECORDS, THIS UIC : 281   PAGE : 25

CATEGORY OF RESOURCE	WORK UNITS	MIL PERS	CIV PERS	TOT PERS	MIL $/HR	CIV $/HR	MIL HOURS	CIV HOURS	MIL LABOR COST	CIV LABOR COST	SUPPLIES COST	CONTRACT COST	MISC COST	TOTAL COST
CMD & STAFF TOTAL	11043	178	325	502	4.94	2.19	369238	675125	1825131	1479863	393418	362348	108877	4169637
DIRECT		175	323	498	2.58	0.44	364205	671339	940341	298483	12969	62540	22907	1337140
ACTY SUPPORT		0	0	0	0.00	0.00	0	0	839302	1152980	378849	298808	54687	2724626
HOST SUPPORT		0	0	0	0.00	0.00	0	0	0	0	0	0	0	0
PROJ OVERHAUL		0	0	0	0.00	0.00	0	0	0	0	0	0	23444	23444
CNTECHTRA COST		2	2	4	9.04	7.50	5033	3786	45488	28400	1600	1000	7839	84327
HOSPITAL		0	0	0	0.00	0.00	0	0	0	0	0	0	0	0
FAMILY HOUSING		0	0	0	0.00	0.00	0	0	0	0	0	0	0	0
STAFF PCS		0	0	0	0.00	0.00	0	0	0	0	0	0	0	0
EQUIP MAINT		0	0	0	0.00	0.00	0	0	0	0	0	0	0	0
EQUIP DEPR		0	0	0	0.00	0.00	0	0	0	0	0	0	0	0
STUDENT PCS		0	0	0	0.00	0.00	0	0	0	0	0	0	0	0
STUDENT SALARY		0	0	0	0.00	0.00	0	0	0	0	0	0	0	0
SUPPORT TOTAL	0	183	668	851	3.12	5.93	380957	1389584	1190333	8245717	5044507	4092713	380716	18953986
DIRECT		183	668	851	3.12	5.93	380957	1389584	1190333	8245717	5044507	4092713	380716	19953986
ACTY SUPPORT		0	0	0	0.00	0.00	0	0	0	0	0	0	0	0
HOST SUPPORT		0	0	0	0.00	0.00	0	0	0	0	0	0	0	0
PROJ OVERHAUL		0	0	0	0.00	0.00	0	0	0	0	0	0	0	0
CNTECHTRA COST		0	0	0	0.00	0.00	0	0	0	0	0	0	0	0
HOSPITAL		0	0	0	0.00	0.00	0	0	0	0	0	0	0	0
FAMILY HOUSING		0	0	0	0.00	0.00	0	0	0	0	0	0	0	0
STAFF PCS		0	0	0	0.00	0.00	0	0	0	0	0	0	0	0
EQUIP MAINT		0	0	0	0.00	0.00	0	0	0	0	0	0	0	0
EQUIP DEPR		0	0	0	0.00	0.00	0	0	0	0	0	0	0	0
STUDENT PCS		0	0	0	0.00	0.00	0	0	0	0	0	0	0	0
STUDENT SALARY		0	0	0	0.00	0.00	0	0	0	0	0	0	0	0
DIRECT TRNS TOTAL	11043	154	20	174	36.02	7.78	319636	42298	11511812	329244	119287	20825	801998	12783166
DIRECT		154	20	174	7.81	7.78	319636	42298	2496158	329244	119287	20825	51698	3017212
ACTY SUPPORT		0	0	0	0.00	0.00	0	0	0	0	0	0	0	0
HOST SUPPORT		0	0	0	0.00	0.00	0	0	0	0	0	0	126900	126900
PROJ OVERHAUL		0	0	0	0.00	0.00	0	0	0	0	0	0	0	0
CNTECHTRA COST		0	0	0	0.00	0.00	0	0	0	0	0	0	0	0
HOSPITAL		0	0	0	0.00	0.00	0	0	56300	0	0	0	62700	119000
FAMILY HOUSING		0	0	0	0.00	0.00	0	0	0	0	0	0	155400	155400
STAFF PCS		0	0	0	0.00	0.00	0	0	574800	0	0	0	0	574800
EQUIP MAINT		0	0	0	0.00	0.00	0	0	0	0	0	0	26200	26200
EQUIP DEPR		0	0	0	0.00	0.00	0	0	0	0	0	0	301100	301100
STUDENT PCS		0	0	0	0.00	0.00	0	0	1120000	0	0	0	78000	1198000
STUDENT SALARY		0	0	0	0.00	0.00	0	0	7264554	0	0	0	0	7264554

CRS STAT & SUMMARY	TOT WRK UNITS	MIL PERS	CIV PERS	TOT PERS	MIL $/HR	CIV $/HR	MIL VAR HOURS	MIL VAR COST	ATTR WKS	STUD GRADS	WGHTD LENGH	TOT ATTR	CALC AOB	COST / WK UNT	COST / SDAY	COST / GRAD	TOTAL COST
	11043	514	1013	1527	6.25	2.50	-26881	-120584	968	3281	20.2	117	920	3252	107	15410	35906789

968.00   3281.00   20.23   117.00   920.25   3251.54   106.90   15409.53   2233497.00

XXXXXXXXX XXXXXXX XX   281 26 175 323 940341 298483 98416 0 0 839302 1152980 732344 0 0   0
0 126900 154 20 2496158 329244 191810 183 668 1190333 8245717 9517936 13 301100 920 138 3281 11720.

ACTIVITY SUMMARY OF PER CAPITA COST DATA

FIGURE III-13

Military and Civilian Labor Hours were divided by 2080 HRS/YEAR to calculate the equivalent personnel at the activity. It had been anticipated that these data could be used for apportioning 1000/2 billets; however, because of major discrepancies in Military Labor reporting, this approach was abandoned in favor of a more direct analysis of the 1000/2 report.

The major resource delta calculated by TRAM is billets/ceiling points. CNTECHTRA applies standard rates to officer, enlisted, and civilian positions; therefore, RMS calculations of Military $/HR or Civilian $/HR are not used by the model. The O&MN costs (excluding Civilian Labor), however, can be apportioned on increment/decrement exercises to reflect the change from a specific "what if" action. The initial approach, based upon discussions with RMS personnel was to be:

1) If the change is less than 10%, no O&MN resources could be impacted (other than the direct calculation of civilians by the standard rate formula).

2) On a disestablishment, an elimination of the full O&MN budget would be made. Other add-back costs will be calculated independently.

3) From a 10% to a 100% change, a non-linear function (to be determined) would be applied to calculate the O&MN dollars to be removed or added.

The preliminary algorithms approximating these assumptions are:

1) If 80% or more of instructor personnel are eliminated from an activity, all personnel and all O&MN budget dollars are eliminated.

2) If the change in instructor personnel is 50% or less of the total instructors at an activity, support personnel and O&MN dollars are removed at a rate equal to 40% of the change percentage; i.e., only 20% would be eliminated on a 50% instructor change (.40 x .50).

3) If the change in instructor personnel is between 50% and 80%, support personnel and O&MN dollars are removed at a rate equal to 60% of the change percentage over 50%. Therefore, a 60% change in instructors would produce a 36% change in support and O&MN resources, a 70% change would be 52%, etc. Beyond 80%, assumption 1) takes precedence.

4) Algorithms similar to 2) and 3) also are applied to increments.

SUMMARY OF MODEL DEVELOPMENT. The TRAM development effort fell into two major categories - data processing and logic formulation. Because of the importance of data to TRAM operation, this was a major preoccupation during the development cycle. The NITRAS analyses led to usable default logic

capable of correcting nearly 85% of the missing or invalid NITRAS data. This permitted extremely accurate calculations of instructor requirements where course changes are concerned. Two other aspects of the data - support personnel and costs - were also extensively analyzed. One of the original design premises was the availability of an Activity Support File (ASF). This file was not developed and remains in a very preliminary state of specification. For reasons similar to those which have precluded effective specification of the ASF analysis of support and cost data led to little usable logic within TRAM. Also, certain cost data requested from CNET N6 was not made available due to its apparent sensitivity, thus the support and cost data analyses were incomplete.

A major objective in developing TRAM was to have it cycle from its interactive interface with the user through to a summary output of resources. Preliminary algorithms in the support and cost areas were incorporated to permit the cycling, however, it is expected that major refinements must be made in these areas. However, considering the results of the field test to be discussed in Section IV of this report, it appears that the techniques developed and the balance in development emphasis matched many of the requirements for planning at CNTECHTRA.

SECTION IV

TRAM FIELD TEST AT CNTECHTRA

FIELD TEST OVERVIEW

INTRODUCTION. The TRAM system was subject to an intensive three-week trial during the period 12 October to 29 October 1976. This user trial was conducted at CNTECHTRA. The chief user of this model during this test was the Plans, Programs & Facilities Department (N-2), followed by the Management Department (015), and the Resources Management Department (N-5). A short demonstration was given to a Training Program Coordinator (TPC) during this test. Discussions were held with numerous personnel in an effort to understand applications of the model and to develop the logic for necessary enhancements. A demonstration of the system was also given to CNET at Pensacola on 27 October 1976 in an effort to broaden the base of understanding of the TRAM logic and to exchange information that would be used in further development in the areas of TRAM technology. During this period, the necessary information was gathered to (1) estimate the utility of the TRAM system, (2) estimate the cost of operation of the TRAM system under a variety of configurations, (3) recognize deficiencies in the TRAM system, and (4) develop the recommendations necessary for continued development of the TRAM technology.

ENVIRONMENT. This test was physically conducted in the offices of N-2 at CNTECHTRA. The programs used in this test were located on two identifications of the National CSS timeshare system. Access to this system was via dial-up telephone circuits. Both local (Memphis) and in-dial WATS lines are available in the area. The principal terminal used was the Teletherm 1030 printing terminal, although compatibility was established with other 30 CPS CRT terminals located at CNTECHTRA. No local high-speed printer was available during this test. The data base for this test consisted mainly of data gathered from NITRAS, dated 15 June 1976, the 1000/2 files dated June 1976, and the Per Capita Cost (PCC) data for Fiscal Year 1975. These data were approximately 3 months old for the operational test (the PCC data were "current," as no new fiscal year data were available).

OBJECTIVES. The objectives of this field test were:

1. To test the TRAM system in an operational environment.

2. To determine the applicability of the TRAM technology to CNTECHTRA's requirements.

3. To identify major deficiencies in the TRAM system.

4. To identify enhancements that would be desirable.

5. To determine operational costs for typical problems.

6. To record overall system reliability.

OPERATIONAL TEST ACTIVITIES

The TRAM operational test was broken into three parts. The first week was devoted to demonstrating the system to Codes N-2 (Plans, Programs and Facilities), N-5 (Resources Management) and 015 (Management) personnel at CNTECHTRA. The second and third weeks were spent applying problems presented by these personnel to the TRAM system. During the final week, training was conducted with N-2 personnel to allow ongoing operation of the system.

INITIAL DEMONSTRATIONS. The initial demonstrations were intended to demonstrate to non-computer oriented personnel the capabilities of the TRAM system, the ease of operation, and the potential results that could be obtained. During these periods, specific questions were asked so as to obtain data necessary for evaluation of an improvement to the TRAM system. Several recommendations were immediately incorporated into the system as a result of these discussions. These are documented later in this section.

OPERATIONAL EXAMPLES. Per previous request, several operational examples were submitted for TRAM execution. A summary of the types of problems encountered is as follows:

1. Problems requiring instructor computations to allocate instructors to courses.

2. Decrementing and consolidation of complex actions.

3. Actual problems requiring an immediate response. The data were several months old, thus preventing actual use of the results calculated by the model.

MODEL DEFICIENCIES/CORRECTIONS

Model deficiencies noted during this evaluation:

1. The persons using the model were accustomed to working with activity names rather than UIC codes. The model obviously must work with these codes. This problem was alleviated in two ways. First, a listing of all activities, their codes, and a summary of authorized billets, was included as an appendix to Technical Memorandum 76-3. Second, program TST and executive LOOK were written to permit the user to look up any course in NITRAS to ascertain UIC codes.

2. There was an identified requirement for more detail. This was exemplified by the request for a listing of instructor requirements by course for all courses involved in an action. Program LISTIC and executive ICOMPIO were written to provide this instructor summary by CDP.

   A need existed for more detailed output from subroutine COST. This increased output could not be accommodated during the evaluation period.

3. The program encountered problems when consolidations were attempted at activities where the same CIN was taught under multiple CDP's. The most prominent examples of these are BE&E and AFUN courses. The consolidation

logic was changed to minimize the impact of this. However, an across-the-board fix could not be made as the courses have many common modules and resources. This problem will exist until a better way is devised to load these courses in NITRAS.

4. Problems were encountered using the system default for planned input data. In several cases, the AOB and hence the instructor requirements generated by the model were quite high due to the absence of planned input and the default value was too high. The system default was removed and the problem became worse in the opposite direction. Further analysis proved the missing loads were generally related to self-paced courses. The default logic was again reprogrammed, and the values now appear reasonable.

5. Several other minor problems were corrected during the user evaluation.

SYSTEM PROBLEMS

Twice during the evaluation period the timeshare vendor's system was unavailable for significant periods. The first period of downtime was on the first day of demonstrations, causing an impact to the initial "kick off" meeting. The second period of downtime was on the last full day of the evaluation, impacting the training of follow-on users. Periods of downtime as significant as these have not been previously experienced, and it is doubtful that they should continue.

The telephone system also caused minor problems. The local Memphis telephone number, as provided by the timeshare vendor, consistently proved too noisy and at too low an amplitude for reliable terminal operation. However, the dial-WATS lines to the multiplexer in Atlanta had none of these problems, so operation was not affected.

Other minor equipment problems encountered during this test were due to blown fuses on the portable terminal.

CONCLUSIONS AND RECOMMENDATIONS

Based upon experience gained and discussions held during the test period, the following conclusions and recommendations are made.

CONCLUSIONS

Operational Test Results. The model was tested in approximately 20 significant configurations during this user test, with many variations to these basic runs. The following summarize the results of running these problems. These conclusions are based on analysis of the 34 decrements proposed by CNTECHTRA as a preliminary test to measure the applicability of TRAM to this type of exercise.

1. The TRAM model, as presently configured, does have applicability in the CNTECHTRA organization.

2. The most useful feature in the TRAM model is the ability to quite accurately calculate instructor requirements based on "raw" data in NITRAS.

3. The default concept, where course data gathered from an extensive parametric analysis are used to substitute for invalid or sketchy NITRAS data, was established as a viable operational tool without which these instructor computations would not be possible.

4. The alternate (or distributed) data base concept, where a portion of the NITRAS data is duplicated and online on a second computer, is justified and cost effective.

5. The 1000/2 file by its very nature must be the "master" file controlling the model determination of what constitutes an activity. All other files must be slaved to this file. Where other files cannot be slaved to the 1000/2 file (such as the Per Capita Cost file), the deviations must be handled as exceptions.

6. The most useful operating mode for TRAM is consolidation option. This is due to (1) there is a substantial reduction in the manual labor required to evaluate a consolidation, and (2) there is a great deal more multiple siting of courses than was thought to be the case by CNTECHTRA personnel.

7. The weakest area in the TRAM model is the logic used to calculate support and command/staff overhead personnel required at an activity.

8. The costing, or economic analysis, provided by TRAM is somewhat inadequate due to the gross approximation techniques used in developing the overall personnel affected in a decrement action.

9. The major application of the TRAM model was to evaluate decrement actions and consolidations; the only increments were additional loads placed in existing courses.

Data Requirements. The data requirements applicable to the TRAM model can be divided into four basic categories. These categories are as follows:

Congressional Reporting Systems. These data are the data required for the Military Manpower Training Report (MMTR) and for various phases of the budget cycle. These requirements were studied in some detail when drawing up the specification for the TRAM model. Essentially, the source data for these reports are in NITRAS. However, the NITRAS MCRF data in many cases are merely playing back to these people data they loaded or controlled in the first place. These data are marked by two common attributes. First, the accuracy must be carried down to the last "nut and bolt." It is important in the MMTR whether 21 or 23 foreign students plan to take a course. Likewise, it is important whether pipeline delays affect USN or USNR personnel. Second, a complete trackability, or audit, trail is required. It is important to know, or be able to recover, what figure was reported three or six months ago and

have a record of why it differs in the latest submission. These data requirements do not lend themselves to aggregate flow models with default characteristics such as TRAM. These data requirements are best filled by a system such as NITRAS. In fact, in the future these requirements may become very specialized in NITRAS. Also, some potential model applications can be handled by summation reports due to large amounts of data carried to meet Congressional reporting requirements.

Billet Data. Billet data at first were thought to have the same exacting requirement as the above data. It is important for the programming branch (CNTECHTRA N22) to know every billet of every type they are authorized by location. There is a continual flow of data from the activities to CNTECHTRA, usually through the 1000/2 files. Billets are carried to exacting levels, and are organized basically by courses taught. On the surface, there appears little utility in using TRAM in assisting this process.

However, two major and somewhat interrelated problems have potential for TRAM utility. The first problem is that all updates by the activity to the 1000/2 files are not made simultaneously and that there may be considerable delay in getting the updates made (on the order of several months). Once these updates are made there is no certainty that the 1000/2 reports will be printed and mailed to CNTECHTRA. The second problem is that the billets cannot always be tied to a course. For example, at Fleet ASW Training Center, San Diego, nearly one-third of all courses taught were of sufficiently small capacity, or were taught at such low convening frequency, that no instructors were justified directly by those courses. This factor, coupled with the timeliness of updating of the 1000/2 files, makes ascertainment of billet assignment by CNTECHTRA personnel difficult. This fact was highlighted through a CNET request made during the evaluation period for instructor authorized billets, by course. This information was not readily available at CNTECHTRA, and was complicated by the fact that all 1000/2's were not and could not be arranged to facilitate this kind of request. This problem was entered and run using the TRAM model, with an answer obtained immediately. The TRAM results were not passed on to CNET as the data base was three months old and not enough operating experience had been obtained with the model. An after-the-fact analysis established that the model results were valid. This indicates that the model has applicability in the area of tying authorized instructor billets to actual courses taught.

Reprogramming. This is the area discussed previously where current assets (basically instructors) are reassigned to meet new or expanding requirements. The TRAM model was designed especially to fulfill these requirements.

Long-Range (Facility) Planning. This involves out-year planning where the common denominator is dollars. All resource requirements are converted to this common denominator and the comparative analysis is made. This process, however, is probably the least straightforward one studied. Any process that is not straightforward, or does not consistently follow the same logical pattern, is very difficult to model. Difficulty had been anticipated in developing models for this area of CNTECHTRA's operation, and the inability of TRAM to respond to these types of problems manifested itself throughout the model test.

RECOMMENDATIONS. The recommendations formulated during this user evaluation fall into two categories: those required to correct recognized deficiencies, and those that would project the TRAM technology into useful long-term applications.

The following deficiencies, and recommendations for overcoming these deficiencies, were formulated during the evaluation period.

Data Base Update. Portions of the TRAM logic proved adequate for providing immediate support to CNTECHTRA N-2 without any modification. The utility of the TRAM model was limited, however, by the fact that the NITRAS data base was current for June 1976, while the test was conducted in October 1976. Therefore, many of the problems run were useful for evaluation purposes, but could not be used in an operational environment. For example, SSC at Orlando is just beginning to get up to capacity and become operational for the Basic Electricity and Electronics group of courses. The current NITRAS shows this, yet the NITRAS tape contained only a skeleton of this buildup; therefore, this training center, which was of high interest to CNTECHTRA personnel, could not be adequately analyzed. It is recommended that (1) a current NITRAS file be generated, and (2) procedures be established to allow a regular update of this file (by complete replacement) so that valid operational use of this system is available.

The procedures to accomplish this have been discussed with 015 (Management) personnel at CNTECHTRA and N-73 (Management Information) personnel at CNET.

Correct 1000/2 Analysis Program. It was noted during an analysis of the School of Diving and Salvage that there was a discrepancy between the calculated instructor requirements (31) and the requirements as generated by the 1000/2 analysis program (8). The 31 figure, as developed through the model logic, proved to be correct. An analysis showed that the logic used to analyze the enlisted 1000/2 file needs to be refined. Basically, the logic used to analyze the officer 1000/2 file should be transferred and used on the enlisted file also. This entails reading the text of the billet sequence code title field, looking for keywords such as INST, INSTR, etc., while selecting non-instructor variables to be omitted. The immediate correction for this problem was to update the file (UIC matrix) manually.

Improved Consolidation Logic. Currently, the model allows an activity (or portion) to be closed with the load transferred to up to 13 preassigned activities. This logic should be expanded to allow (1) automatic single siting of courses, and (2) transfer of load from one location to any other location without the need for indicating the receiving activities. This will require the accumulation of courses and projected load in a dummy file for those courses not taught elsewhere.

Command, Staff, and Support Requirements. The logic to determine command, staff, and support billets/ceiling points is inadequate for any detailed analysis of these requirements. During the model development the 1000/2 files, Per Capita Cost System, OPNAV 5320 Manpower Listings, and Host/Tenant Support Agreements, were all intensively studied with the intent of improving this logic. Unfortunately, such improvement proved elusive. Many of the support functions provided by CNET activities are not defined in any of the aforementioned files, especially if this support is to another CNET activity. Many other relationships, such as between RTC's, SSC's, NTC's and their respective ADCOM's are not spelled out in enough

detail to provide any improvement to the existing model logic. TRAM will only be accurate for direct training requirements until these relationships become further defined.

Cost Analysis. The TRAM model only provides cost data for aggregate military and civilian personnel. Military personnel should be broken down into officer and enlisted categories.

Increased Detail Reports. A factor which became apparent during the operational test is that CNTECHTRA needs detailed intermediate data as well as the summary results. For example, they cannot accept a summary total of these savings at an activity without the detail of all factors included in those savings. Two programs were written during the evaluation to improve this deficiency. This capability should be expanded.

RECOMMENDED FUTURE TRAM APPLICATIONS. The previous section discussed the application of TRAM to current operational problems. These applications of TRAM are quite easy to visualize as the problems are real, immediate, and visible. The application of TRAM to more theoretical problems is somewhat harder to visualize. The potential for application of the TRAM technology is perhaps greater with a much increased base for savings, and hence payback, than has been encountered in the immediate operational arena. Some potential applications are delineated below whereby future development might encompass these areas.

Instructor Optimization. Instructor billets are currently authorized based mainly on instructor computation formulas developed by CNTECHTRA. These authorized billets are subject to periodic audit. However, there is not a systematic analysis made to optimize the requirements for these billets. The TRAM model could do this using the following steps.

1. Determine the instructor requirement for handling current input at current convening frequency.

2. Recompute this requirement at the most optimum convening frequency.

3. If the results differ, evaluate any savings, based on instructor requirement reduction versus increased student pipeline costs.

This would require modification to program ICALC to recognize optimum convening frequencies (and perhaps second or third sub-optimization points). A change in logic would have to be made to recognize those courses involved in pipeline type instructional flows. This type of optimization could lead to a more thorough course by course analysis than the aggregate flows permit.

A second possibility exists for more effective instructor utilization. During the field test, most consolidations submitted for evaluation consisted of actions where one training center (X) would be shut down and the load transferred to another center (Y). This resulted in calculated savings at the command, staff, and support levels due to the economies of scale garnered by this consolidation. Instructor savings were not realized in a consolidation since the courses taught at (X) are not taught at (Y), hence they are transferred intact. No problem was

presented where the consolidation was to be evaluated on a course by course basis in an effort to improve instructor utilization. Yet, during some example consolidation problems it was found that a proliferation of courses exists among some activities.

Training System Analysis. NITRAS holds the promise that utilization of the vast amounts of data stored in its system will lead to a greater awareness of the problems of inefficiency in the training command, and would provide the visibility to correct those problems. However, the very mass of data involved, higher priority requests for limited report generation time, and certain data integrity problems, all have combined to keep this potential from being realized. To date TRAM offers a potential for providing this much needed use of NITRAS data.

Typical of the "what if's" that would prove desirable to evaluate are:

1. What is the priority of courses where requirements are greater than the capacities?
2. How many instructors can be freed up by transferring portions of a course to on-the-job training?
3. What trade-offs within resources would meet the greatest number of prioritized requirements?
4. What activity closing order would be indicated by the course training priorities?
5. What savings really would accrue with a more level loading (eliminating cyclic fluctuations)?
6. What is the cost and permissible backlog size required to ensure level loading?

This summarizes just a few of the potential applications where the TRAM technology, in concert with the NITRAS data base, could provide assistance in obtaining the in-depth understanding of complex interactions, so as to effectively make the tradeoffs necessary to maximize instruction while minimizing resource requirements.

OPERATING COSTS

The timeshare vendor's charges can be broken into three parts;

1. Online storage
2. Model operation
3. Data base maintenance

ONLINE STORAGE. The TRAM system currently requires 25 cylinders (120K bytes/cylinder) of permanent storage. Nearly half of this storage is required for the NITRAS summary file. The current charges of this storage are $510 per month, or about $17 per day. During the evaluation period this storage was kept continually online.

However, to minimize storage costs, the system can be stored on magnetic tape and only brought online as required. The cost to read all files to tape is about $15. Thus, if the system is brought up once per week, the costs should be less than $140 per month.

MODEL OPERATION. Two types of charges are incurred during operation of the TRAM model. The first is an hourly charge of $14 per connect hour. The second charge is a processing charge. This processing charge is made up of two components, a VPU, Variable Processor Unit, charge and an I/O charge. A VPU is determined by CSS procedures, and is charged at a rate of 20¢ per VPU. I/O charges are billed at 13¢ per hundred I/O's. One I/O constitutes an 800 Byte string of data. A sample of approximate charges incurred in a model run are as follows:

Program	Base Cost	Variable $ /100 Courses	Total $ /100 Courses	Typical $ /36 Courses
PARAM	.87	NA	.87	.87
TRAM	.87	.51	1.38	1.01
ICALC	.87	.52	1.39	1.06
ICSORT	1.08	1.16	2.24	1.48
IFACE/ COST	3.84	.75	4.59	4.09
DISP	.38	NA	.38	.38
	$7.91	$2.94	$10.85	$8.89

This chart should allow a user to estimate quite closely the charges for a model run. These charges are in addition to the hourly charge ($14/hr.).

When using this table, the following course counts can be estimated for each type of action; i.e., decrements, increments, and consolidations. Each course on a decrement is counted only once; therefore, if there are 36 courses at an activity which is decremented, the run cost would be about $8.89. Using the increment option, a course action must be counted twice - once as a decrement from its current configuration - once as an increment with its new configuration. Therefore, 50 courses being incremented would cost about $10.85 based on the Total $/100 Courses column of the table. For consoldiations, courses are counted once for the decrement action, and then twice more at each "TRANSFER TO" activity which presently teaches the course. However, if it is established as a new course at the "TRANSFER TO" activity, it is only counted once for the increment portion of the action.

DATA BASE MAINTENANCE. There are no established procedures for data base maintenance and, hence, a detailed analysis cannot be made.

However, it can be estimated that two hours of online time will be required to replace a current data base with a new one. Past history has shown that processing charges (including connect time) will average $80 per hour, or about $160 total to replace the data base.

SECTION V

SCRR AND TPF UTILITY ASSESSMENT AT TRAPAC

FINAL STUDY RESULTS

INTRODUCTION

Four major tasks were performed during Phase IV to accomplish the utility assessment of the SCRR and TPF models. The tasks and their performance periods are shown below:

TRAPAC FIELD TEST	3 Jan - 5 Mar 76
MODIFY SOFTWARE TO INCORPORATE ENHANCEMENTS	8 Mar - 9 Jul 76
TRAIN TRAPAC PERSONNEL, INSTALL SYSTEM	12 Jul - 20 Aug 76
SYSTEM DOCUMENTATION	23 Aug - 17 Sept 76

These tasks were defined as a direct result of the DOTS Test and Evaluation performed in June 1975 by the Navy Personnel Research and Development Center. The T&E report published in September 1975 recommended that the DOTS models be installed and subjected to an extended evaluation at a functional level command.

TRAPAC FIELD TEST

The purpose of the field test was to demonstrate the degree of utility that the two previously developed models (SCRR and TPF) and associated data base would have for the Navy training managers at the activity and functional command level.

Five major definable tasks were performed in order to complete the field test. Briefly, they can be described as follows; greater detail is provided in TAEG Report No. 33 - DOTS Utility Assessment:

o Install Software at TRAPAC

The TPF and SCRR models and support programs were reinstalled in the IBM CKF workspace at National CSS. Some minor modifications were made at that time. The data base format was defined and data were collected from five TRAPAC activities. A period of data base purification followed the initial TRAPAC data load operation. Approximately five thousand records (punched cards) were inputted to establish the data base.

- Identify and Document Model/Data Base Applications

  The five TRAPAC activities involved in the field test were briefed on the purpose and schedule for this particular task as well as the following three tasks, which culminated in a review of the field test results by the evaluation team. The objective was to identify situations arising during the normal course of managing training to which the models might potentially apply. Department/division heads and staff personnel were interviewed in order to identify these situations. The result was a list of potential applications.

- Utilize Model Software and TRAPAC to Solve Identified Problems

  Several of the potential model applications were analyzed to a greater depth. Changes or inputs to correspond with the approach taken by training managers in resolving a particular problem situation were prepared. The appropriate model was run and results were compared with those expected by the training managers. Only a few tests of this type could be made because of time constraints and data inconsistencies.

- Define Usability Enhancements

  During the briefings and subsequent interviews, TRAPAC activity personnel identified a number of changes or additions which they believed would make the models more suitable to their use. These ranged from minor data base modifications to new additional modeling tasks. A list of proposed enhancements was maintained for later analysis, prioritization, and possible development.

- Review by Evaluation Team

  A questionnaire (see TAEG Report No. 33) was developed for TRAPAC personnel to determine the frequency and associated workload on identified applications. The results were tabulated and presented to key personnel at each activity. Activities were requested by TRAPAC to develop a position statement regarding the usefulness of DOTS models to the management of training within their function. TRAPAC, Activity, and TAEG personnel (IBM representatives were not present) reviewed the overall field test results to decide the future course of the DOTS effort at TRAPAC. A decision was made to incorporate certain enhancements whereby the transition can be made from R&D to the Operational Phase when resources become available.

MODIFY DOTS SOFTWARE TO INCORPORATE ENHANCEMENTS

Three major enhancements were incorporated into the DOTS models/data base software based upon the COMTRAPAC field test analysis. They include: (1) instructor billet computation, (2) a number of data base modifications which include capability to store a number of direct teaching and support time categories by instructor, and (3) a data base maintenance system. The changes which were developed are shown below:

A. Instructor Billet Computation

A program was developed (in RAMIS) to calculate required instructor billets based upon Demand and Student/Instructor Ratios by CDP. The program, named "ICOMP," is described in Section IV of TAEG Report No. 36 - TRAPAC User's Manual.

B. Data Base Enhancements

1. General data base format changes.

- Three fields for NEC/NOBC were added to the instructor file, e.g., NEC3, NEC4, NEC5.
- Three optional fields of A6 format were added to the course file, e.g., OPT1, OPT2, OPT3.
- Three fields for equipment, space, and instructor capacities were added to the course file, e.g., ECAP, SCAP, PCAP.
- Names of existing JNO and PAOB fields were changed to MAXCAP and MINCAP respectively in course file.
- A field for Planned AOB (PAOB) was incorporated into the course file.

2. The following activity profile data fields were added to the instructor file:

- Hours in contact with student
- Curriculum Development/Task Analysis
- Equipment/Training and Maintenance
- Preparation for Instruction and Related Duties
- In-service Instructor Training ("Break-in" time)
- Cross-training done to take advantage of low student enrollment (not an absolute requirement)
- Factory Training/Workshops, etc.
- Military Duties/Physical Training/Other
- Formal Instructor/Supervisor School
- Fleet Assistance (non-course related)
- Supervision/Administration
- Annual Leave

- Sick Leave

- Special Liberty

C. Data Base Maintenance

A data base maintenance system was designed consistent with a TRAPAC planned future system for maintaining NITRAS. The system incorporates:

o Activity level prompting programs on WANG and storage of changes on a tape cassette.

o Functional level data base management expertise (Data Base Manager) to list and review tapes and transmit them to NCSS on a periodic (weekly) basis.

o NCSS level programs to process changes, trap and print change errors, and prepare data base listings for functional and activity distribution.

TRAPAC PERSONNEL TRAINING/SYSTEM INSTALLATION

The primary objective of this task was to train TRAPAC personnel to operate the DOTS data base, SCRR and TPF model software. The training was accomplished over a five-week time period through hands-on operation of the DOTS software. At the conclusion of the training period COMTRAPAC and the training activities will perform an extended evaluation of the DOTS data base and models.

A secondary objective was to use the maintenance system software to bring the DOTS data files up-to-date and to determine the cost required to maintain the DOTS data base in terms of manpower and NCSS computer costs.

Meetings were held with key personnel at each of the training activities to initiate the data base update task. A preliminary DOTS data base maintenance administrative system was developed. Software modifications required to install the WANG software on the TRAPAC hardware were implemented. Initial training for the Data Base Manager (DBM), including an introduction to NCSS and RAMIS conventions, was started while maintenance data were being collected by the training activities. Personnel at each of the activities were then trained to record maintenance data on a tape cassette using the WANG interactive prompting program. Tape cassettes containing maintenance data were sent to the DBM as they were completed. The DBM was then trained to process the maintenance transactions into the DOTS data base using NCSS/RAMIS procedures. The TRAPAC training schedule and a summary of the training tasks/topics is shown in Figure V-1.

COLLECT MAINTENANCE DATA. A DOTS data base was established for all TRAPAC activities in January 1976. (See TAEG Report No. 33 - DOTS Utility Assessment.) Since the data base had not been updated for a six-month period, the number of changes required to bring the data base up-to-date will provide a basis for projecting weekly maintenance activity. Also, inputting and processing twenty-six weeks of data base changes provide an opportunity to engage in extensive on-the-job training for both activity personnel and the DBM.

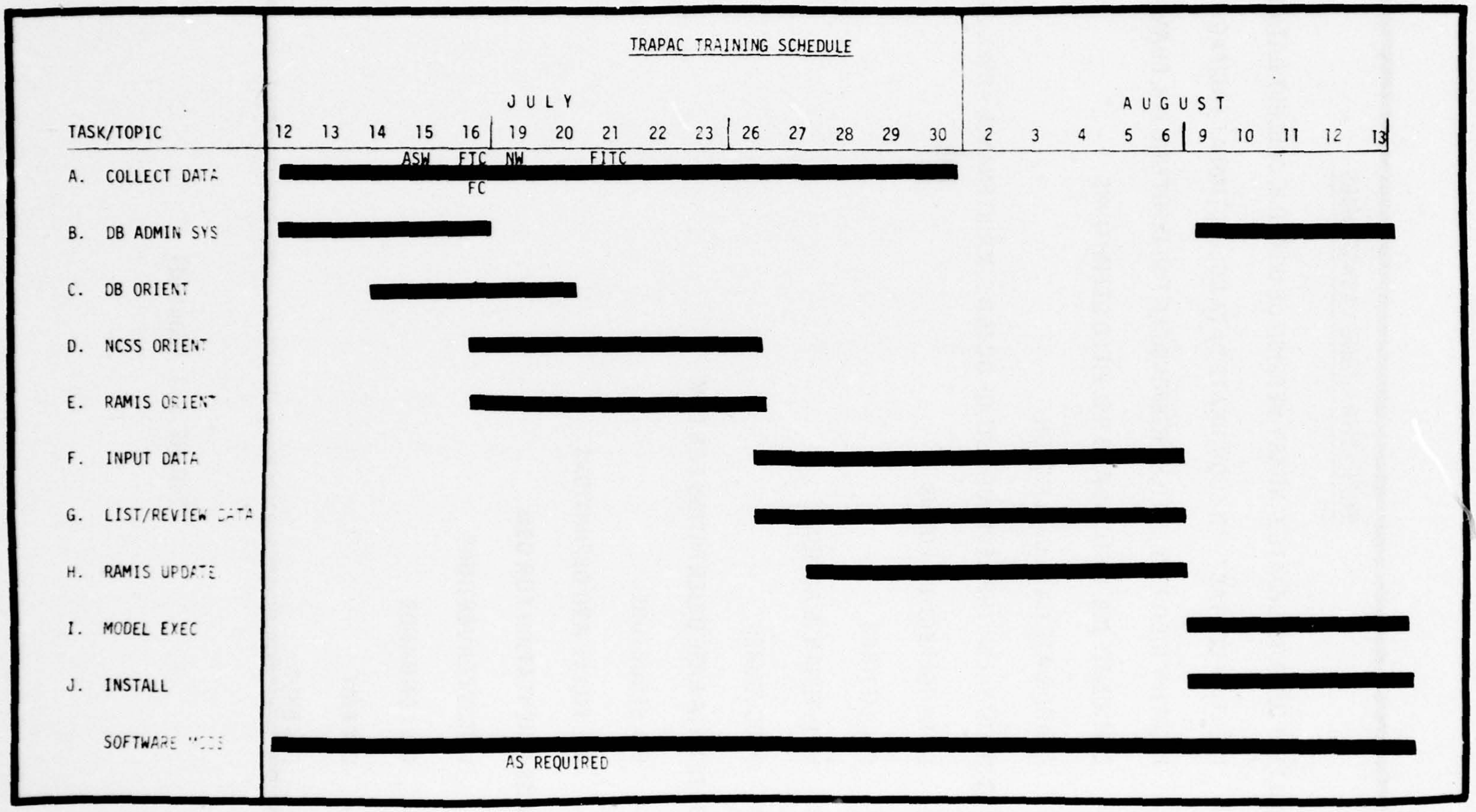
TRAPAC TRAINING SCHEDULE
JULY
AUGUST
TASK/TOPIC
12 13 14 15 16 19 20 21 22 23 26 27 28 29 30 2 3 4 5 6 9 10 11 12 13
ASW
FTC
FC
NW
FITC
A. COLLECT DATA
B. DB ADMIN SYS
C. DB ORIENT
D. NCSS ORIENT
E. RAMIS ORIENT
F. INPUT DATA
G. LIST/REVIEW DATA
H. RAMIS UPDATE
I. MODEL EXEC
J. INSTALL
SOFTWARE MODS
AS REQUIRED

FIGURE V-1

TRAPAC TRAINING TASKS/TOPICS

A. COLLECT DATA TO UPDATE JANUARY VERSION OF DOTS D.B; COLLECT DATA FOR NEW D.B. FIELDS.

- IDENTIFY CONTACTS TO COORDINATE DATA COLLECTION AT EACH ACTIVITY
- IDENTIFY INDIVIDUALS TO BE RESPONSIBLE FOR INPUTTING D.B. CHANGES ON WANG
- DISTRIBUTE D.B. LISTINGS AND D.B. FIELD DEFINITIONS
- COORDINATE DATA COLLECTION

B. ASSIST TRAPAC IN THE DEVELOPMENT OF DOTS D.B. MAINTENANCE ADMINISTRATIVE SYSTEM

- DATA COLLECTION FORMS
- D.B. LISTINGS
- MAINTENANCE ACTIONS
- PROCEDURES

C. DOTS DATA BASE ORIENTATION FOR DBM

- D.B. STRUCTURE
- D.B. FIELDS AND DEFINITIONS

D. NCSS ORIENTATION FOR DBM

- VP/CSS CONVENTIONS
- CSS COMMANDS
- CSS EDIT
- CSS EXEC

FIGURE V-1 (Cont'd)

TRAPAC TRAINING TASKS/TOPICS (CONT'D)

E. NCSS/RAMIS ORIENTATION FOR DBM

- RAMIS INPUT MODE
- RAMIS REVISE MODE
- RAMIS SCAN MODE
- RAMIS REPORT GENERATION

F. TRAIN REPRESENTATIVE(S) FROM EACH ACTIVITY TO USE WANG D.B. MAINTENANCE PROGRAM

- INPUT UPDATES AND NEW DATA TRANSACTIONS USING WANG PROMPTING PROGRAM
- FAMILIARIZE DBM WITH THE OPERATION OF THE ACTIVITY MAINTENANCE PROGRAM

G. TRAIN DBM TO LIST AND EDIT ACTIVITY MAINTENANCE TRANSACTION TAPE ON WANG EQUIPMENT

- REVIEW OF ACTIVITY TRANSACTIONS BY TRAPAC REPRESENTATIVE

H. TRAIN DBM TO PROCESS MAINTENANCE TRANSACTIONS USING NCSS/RAMIS PROCEDURES

- ANALYSIS OF TRANSACTION ERRORS
- RAMIS ERROR RECOVERY TECHNIQUES

I. MODEL EXECUTION AND CONTROL

- TPF
- SCRR

J. INSTALL ADMINISTRATIVE SYSTEM

FIGURE V-1 (Cont'd)

Meetings were held with key personnel from each of the TRAPAC activities from 15 July through 21 July. (See Figure V-1.)

All activity personnel attending these meetings were involved in the January data collection and subsequent utility assessment. The object of the meetings was to describe data base and model enhancements incorporated as a result of the utility assessment, to distribute listings of the three (Course, Facility, and Instructor) data base files, and to discuss the data base update and the maintenance training schedule.

Data changes occurring since January were noted by redlining the data base listing. Blank forms to collect data for new instructors and courses were provided. The major portion of the data collection effort was required to establish instructor activity profile data. The activity profile is an estimate of the number of hours expended on an annual basis on each of fourteen activity categories. Time to collect these data ranged from fifteen (15) minutes per instructor at one activity to ninety (90) minutes per instructor for one department at another activity. The effort required to collect activity profile data is not repetitive. The initial activity profile data must be collected only once for each instructor. The effort required to collect and record course and facility data changes ranged from 75 to 100 changes per hour.

TRAIN ACTIVITY PERSONNEL. After the maintenance data were collected and recorded on the data base listings, personnel at each of the activities were trained to operate the WANG data base maintenance prompting program. The prompting program requests the user to enter required data and then records the data on a WANG tape cassette. Training time ranged from one to three hours per person. The rank of personnel trained to input maintenance data ranged from enlisted E-1 to Commander. Prior ADP background ranged from none to several years of programming experience. Operation of the WANG prompting program required very little explanation. The major portion of the training time was devoted to an explanation of the data base structure and the twenty types of maintenance transactions. All trainees became proficient in entering maintenance transactions after a single training session, plus one to two hours of hands-on experience entering data changes on the WANG computer terminal.

Approximately 13,000 data changes were entered by activity personnel during the second and third weeks of the training program. The time spent on the WANG terminal to enter the maintenance transactions ranged from 125 to 200 transactions per hour.

TRAIN DATA BASE MANAGER. After all maintenance transactions were entered on the tape cassette, the cassette was delivered to the DBM at COMTRAPAC. The remainder of the data base maintenance task is then performed by the DBM. The DBM must:

1. List and review maintenance transaction tape cassette.

2. Transmit data on tape cassette to NCSS disk.

3. Process maintenance transactions using NCSS/RAMIS procedures.

4. Resolve and correct any maintenance data errors identified by RAMIS.

5. Generate and distribute new data base listings.

Approximately four weeks were devoted to DBM training. The following material was covered during the training program:

1. TAEG Report No. 36 - DOTS TRAPAC User's Manual

2. VP/CSS Reference Manual (NCSS Form 106)

3. VP/CSS Edit Command (NCSS Form 108)

4. VP/CSS Executive Language (NCSS Form 109)

5. RAMIS User's Guide (Parts 1, 2 and 3)

In addition to the theoretical background achieved through review of the above documents, twenty-six weeks of data base changes (approximately 13,000 changes) were processed and entered into the three RAMIS data files during the third and fourth weeks of the training program.

NOTE ON NCSS-WANG INTERFACE SOFTWARE. All NCSS-WANG interface is controlled by the program "TC-NCSS." "TC-NCSS" was written in BASIC using statements from the General I/O Instruction Set by WANG Laboratories in Tewksbury, Massachusetts. The only unresolved technical problem encountered during the installation and use of DOTS software involved the use of "TC-NCSS" to transmit data from the WANG disk to the NCSS disk. As the program is currently written, the occurrence of "noise" in the telecommunications link is sufficient to disrupt data transmission. This means that the DBM must determine the last data record successfully transmitted and restart the transmission process. Since telephone line "noise" is least likely to occur after normal working hours, the problem was temporarily solved by transmitting data from WANG to NCSS after 5 P.M. This problem was discussed with the WANG district systems analyst, who has provided a skeleton program, which coupled with the installation of a new Telecommunication Interface board has alleviated the problem.

SUMMARY OF MAINTENANCE PROCESSING COSTS. The six-month DOTS data base update performed in conjunction with the TRAPAC training program not only provided the means to gain extensive hands-on processing experience for activity personnel and the DBM but also provided sufficient data to project weekly maintenance costs. A summary of the data base maintenance activity and costs is presented in Table V-1.

The first column in Table V-1 shows the name assigned to the transaction file on the NCSS disk. The date is the date the file was transmitted to NCSS. Each file may contain one or several WANG tape cassettes. The second column shows the total number of maintenance transactions recorded on the WANG tapes. Included in the total of 12,887 transactions are 7,772 instructor type 3 transactions. The major use of type 3 transactions was to input instructor activity profile data. Since the activity profile data is new data and will not be entered in total on a periodic basis, it will be excluded from the maintenance activity projection. However, profile data will have to be added for new instructors. Assuming that 150 new instructors will report during a six-month period, and also assuming an average of 10 profile records per instructor, means that 1,500 of the 7,772 instructor records could be considered to be recurring. Therefore, of the 12,887 total transactions 6,272 records were

DATA BASE MAINTENANCE SUMMARY

Assigned File Name		# Input Records on Change Tape	# Inst. Data Records (Type 3)	# Records Deleted-CSS Edit	# Records Entered Into Ramis Files				NCSS Costs	
Activity	Date				Del.	Add	Chg.	Tot.	Total	Per Input Trans.
FITC	0726	361	146	15	45	32	269	346	$ 185.85	51.5c
FCD	0730	998	0	3	51	136	801	988	115.18	11.5c
FTC	0801	1,478	1,031	125	0	39	1,273	1,312	336.68	22.8c
FTC	0802	1,021	623	37	4	15	955	974	280.89	27.5c
FCD	0802	1,025	681	48	27	117	829	973	256.59	25.0c
ASW	0802	1,332	919	375	8	57	688	753	283.60	21.3c
FTC	0805	1,700	1,097	22	53	42	1,573	1,668	391.20	23.0c
ASW	0805	1,096	764	45	50	68	853	971	220.66	20.1c
ASW5	0806	199	184	0	0	15	184	199	28.04	14.1c
ASW3	0806	623	430	0	9	15	558	582	138.65	22.3c
ASW2	0806	1,350	1,309	13	28	9	1,263	1,300	371.25	27.5c
FCD	0806	493	302	0	8	112	371	491	181.33	36.8c
ASW	0807	658	0	1	29	173	410	612	115.84	17.6c
NW	0807	553	286	0	5	16	493	514	115.48	20.9c
Totals		12,887	7,772	684	317	846	10,520	11,683	$3,021.24	23.4c

TABLE V-1

required to input new data for instructors already in the file and are consequently non-recurring inputs. The total number of recurring maintenance transactions for a six-month time period was 6,615, or 255 transactions per week.

A total of 11,683 deletions, additions, or changes were made to the RAMIS files. A total of 684 records were deleted from the input files prior to RAMIS processing using the CSS Edit command. Some number of records were also modified prior to RAMIS processing using the Edit command. Edit costs are included in the NCSS cost column. A total of 520 records (12,887 -(11,683 + 684)) were rejected by RAMIS and were not entered. An additional number of records were also rejected by RAMIS but were analyzed, modified and reentered as part of the training program. Although the number of rejected transactions which were reentered was not recorded, the number is estimated to be near 500. All costs associated with analyzing, modifying, and reentering these transactions are included in the NCSS cost figures.

From Table V-1, the NCSS processing cost per input transaction ranged from a low of 11.5¢ to a high of 51.5¢. This wide range is due mainly to the dual objective of the exercise. In addition to updating the data base, the maintenance transaction processing also served as a training vehicle for the DBM. This is especially true for the first file processed which averaged 51.5¢ per transaction. Other factors affecting the cost per transaction are the input data error rate, the mix of transaction types, and the number of RAMIS errors which were analyzed, corrected, and reentered. The processing cost per transaction for periodic maintenance is projected to be in the 15¢ to 20¢ range.

ADDITIONAL NCSS COSTS. In addition to the processing costs shown above, two other NCSS costs should be considered: (1) cost to generate data base listings, and (2) permanent storage costs.

The current cost to generate a complete TRAPAC data base listing is approximately $100. A technique to eliminate this cost is being pursued by the WANG district systems analyst. This technique involves transmitting the sequential data base file from NCSS to the WANG disk, and then formatting and printing the file on the WANG computer. If this technique proves to be feasible, the cost to generate data base listings would decrease to approximately $15.

Permanent storage requirements for the DOTS data base and the SCRR and TPF model software is 23 120,000-byte cylinders. At current rates, the daily cost of 23 cylinders is approximately $20. To minimize storage costs, permanent storage should be brought on-line for not more than one day per week (if maintenance is to be performed weekly). This can be accomplished by storing all NCSS files on magmetic tape. The cost to load all files from tape to permanent disk is approximately $15. The cost to write the disk files back to tape is also $15.

PROJECTED MAINTENANCE COSTS

	RATE	AVG. COST/WK (255 TRANS/WK)	WORST CASE AVG. COST/WK (510 TRANS/WK)
COLLECT DATA*	75/HR 100/HR	3.4 HR 2.6 HR	6.8 HR 5.1 HR
ENTER DATA*	125/HR 200/HR	2.0 HR 1.3 HR	4.0 HR 2.6 HR
NCSS PROCESSING COST	15¢/TRANS 20¢/TRANS	$38.25 $51.	$ 76.50 $102.
DATA BASE LISTING**	$ 15/WK $100/WK	$ 15. $100.	$ 15. $100.
NCSS DISK STORAGE***	$ 50/WK	$ 50	$ 50.
TOTALS	MINIMUM	3.9 HR + $103	7.8 HR + $142
	MAXIMUM	5.4 HR + $201	10.8 HR + $252

* TRAPAC Total

** One complete TRAPAC listing per week

*** 23 Cyl. one day/week, loaded from tape and saved back on tape

SYSTEM DOCUMENTATION

Documentation, consisting of a combined user's guide and programmer's manual for the DOTS data base, the SCRR and TPF models, was published in September 1976 as TAEG Report No. 36 - Design of Training Systems, TRAPAC User's Manual.

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